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TELEVISION LIGHTING: The article on page 84 is ostensibly about studio lighting for television. However, the observations and the methods apply equally to ordinary photography. It's well worth reading.

GADGETS FOR CARS: The "Reader Built It" feature from page 98 is devoted to electronic gadgets which can be fitted to motor vehicles.

COAXIAL CABLES: How often have amateur operators wondered about a piece of cable in their shack. Is it 50 ohms or 70 ohms? The tables on pages 96 and 97 should help resolve such questions.

AUDIO OSCILLATOR: The instrument on page 74 breaks new ground in terms of both simplicity and performance. Covering the full audio spectrum, it has an extremely low distortion content.

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EDITORIAL VIEWPOINT

by Neville Williams

FM broadcasting enquiry

On May 7, the Postmaster-General, Mr A. S. Hulme, announced that there would be further public enquiry into the desirability of introducing frequency modulation into Australia. To the champions of the system, who have been discouraged and frustrated for so long, the announcement must have come as something of a surprise.

The timing of the announcement is much more understandable, however, when it is realised that the Australian Broadcasting Control Board has recently completed its preparatory work for colour television, to the point where standards and tolerances for the Australian system can be announced. It is now a matter for the Federal Government to name a date for "C-Day."

In the meantime, the Australian Broadcasting Control Board will presumably have a breathing space to concern itself with other matters, of which FM Broadcasting would be far and away the most significant.

It must not be assumed, however, that the announcement of an enquiry automatically means that FM is on the way. The recommendation from the enquiry may be "yes," "much later" or "no". Certainly, Mr Hulme's remarks at the time of the announcement gave little cause for optimism, with the impression that he — and presumably Cabinet as a whole — will need to be faced with some very convincing argument before they will go along with a positive recommendation.

In the main, two classes of listeners could benefit from an FM system, and both could be bitterly disappointed if it is not guided along the right lines.

The first group involves listeners in those country areas where medium-wave AM signals simply do not compete successfully with atmospheric and electrical noise, and with interference from other stations. Networks of FM transmitters, possibly remotely controlled and fed by landlines, could bring such listeners clean radio signals for the first time.

But such listeners could find themselves low down on the priority list, unless they make their voice heard long and loud, as from now.

The other major group involves listeners with a genuine interest in wide-range, noise-free high-fidelity sound. This group could also be bitterly disappointed if FM turned out, as it easily could, to be merely a higher quality juke box. The most effective insurance for something better than this would be strong pressure to instal FM as a stereo system from the very outset, with the aim of building a stereo-conscious audience.

In the ultimate, programs are determined not by hopes and convictions expressed at an enquiry, but by the actual audience which a system collects around itself.

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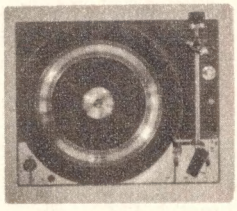

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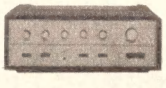

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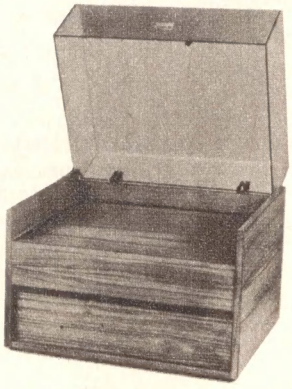

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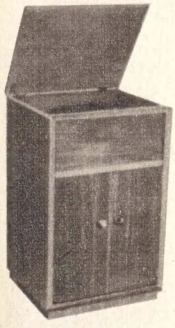

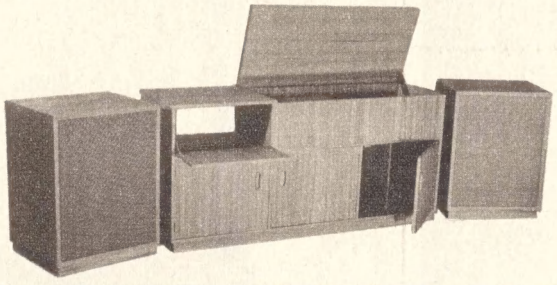

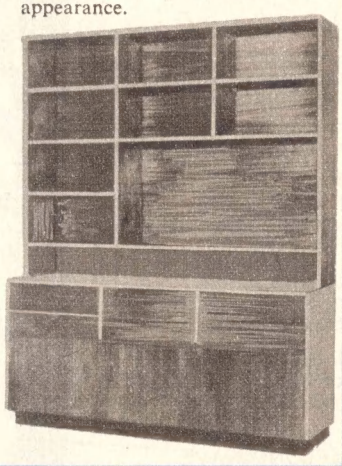

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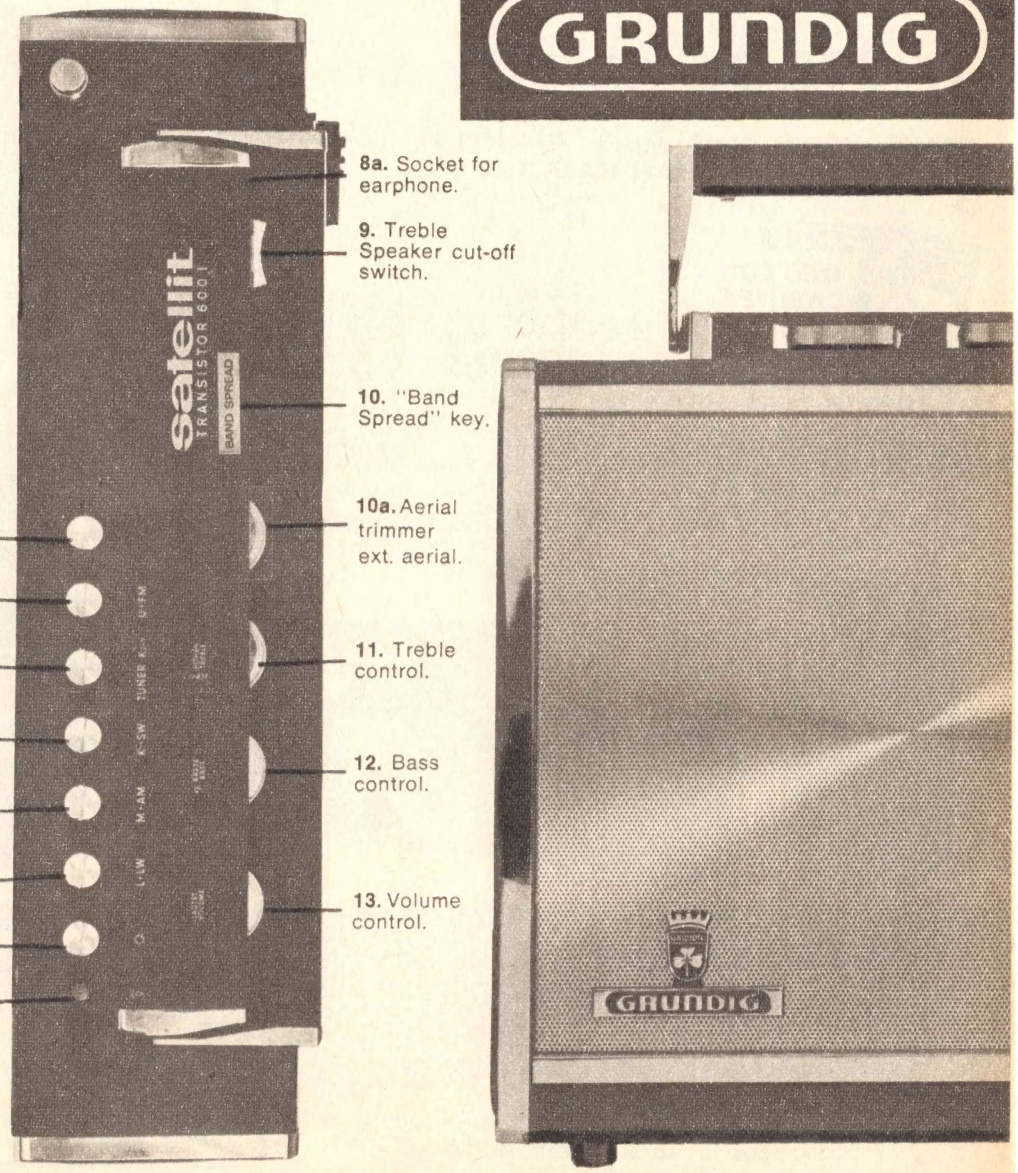

8. Selector Car/Outdoor Aerial.
7. Press button for FM.
6. Press button for SW Tuner (SW 2-SW 9).
5. Press button for SW 1 (60-187 m).
4. Press button for MEDIUM WAVE (AM).
3. Press button for LONG WAVE.
2. Press button for PU.
1. Press button for dial scale illumination (battery operation).

8a. Socket for earphone.
9. Treble Speaker cut-off switch.
10. "Band Spread" key.
10a. Aerial trimmer ext. aerial.
11. Treble control.
12. Bass control.
13. Volume control.

Grundig Transistor 6001

Technical Specifications:

20 tuning ranges: FM, 17 x SW (SW 1: 60-187 m, SW 2: 42-60 m and 49 m band, SW 3: 36-50 m and 41 m band, SW 4: 26,5-37 m and 31 m band, SW 5: 21,5-30 m and 25 m band, SW 6: 16,5-24 m and 19 m band, SW 7: 14-20 m and 16 m band, SW 8: 12-16,7 m and 13 m band, SW 9: 10-14 m and 11 m band), Medium Wave (AM) and Long Wave • circuits: FM 14 (3 can be tuned), AM (without SW Tuner) 9 (3 can be tuned); SW Tuner 14 (3 can be tuned) • 19 + 1 transistors (17 of these are silicon trans) • best possible cross modulation by field effect transistors • 14 + 2 diodes • tuned-in first stage on all ranges • double superimposition of SW Tuner with 4-circuit band filter • gain control: AM 3-stage, SW Tuner 3-stage with additional control, FM 1-stage • ferrite aerial for MW (AM) and LW; MULTI-MATCH telescopic aerial for FM and SW (switchable) • DUPLEX Single Selector tuning • separate SW rotating drum selector drive by means of a pull-and-push tuning knob • colour marks for station tracing • SW fine tuning for SW 1 • "Band Spread" key • switchable AFC on FM • AM band width selector switch • tuning indicator (S-meter) • battery voltage indicator • 2 Superphone speakers (treble speaker can be switched off) • bass and treble control • 2 Watts push-pull output stage • battery operation by 6 x 1,5 V mono cells • built-in mains power pack TN 12 • dial scale illuminated • sockets for external power supply, earphone, external speaker, outdoor aerial, car aerial, outdoor dipole antenna, ground, record player/tape recorder • receptacles for SSB device with switch-over to manual control, sound filter, product demodulator • cabinet: wood, w/leatherette covering, in black and walnut.

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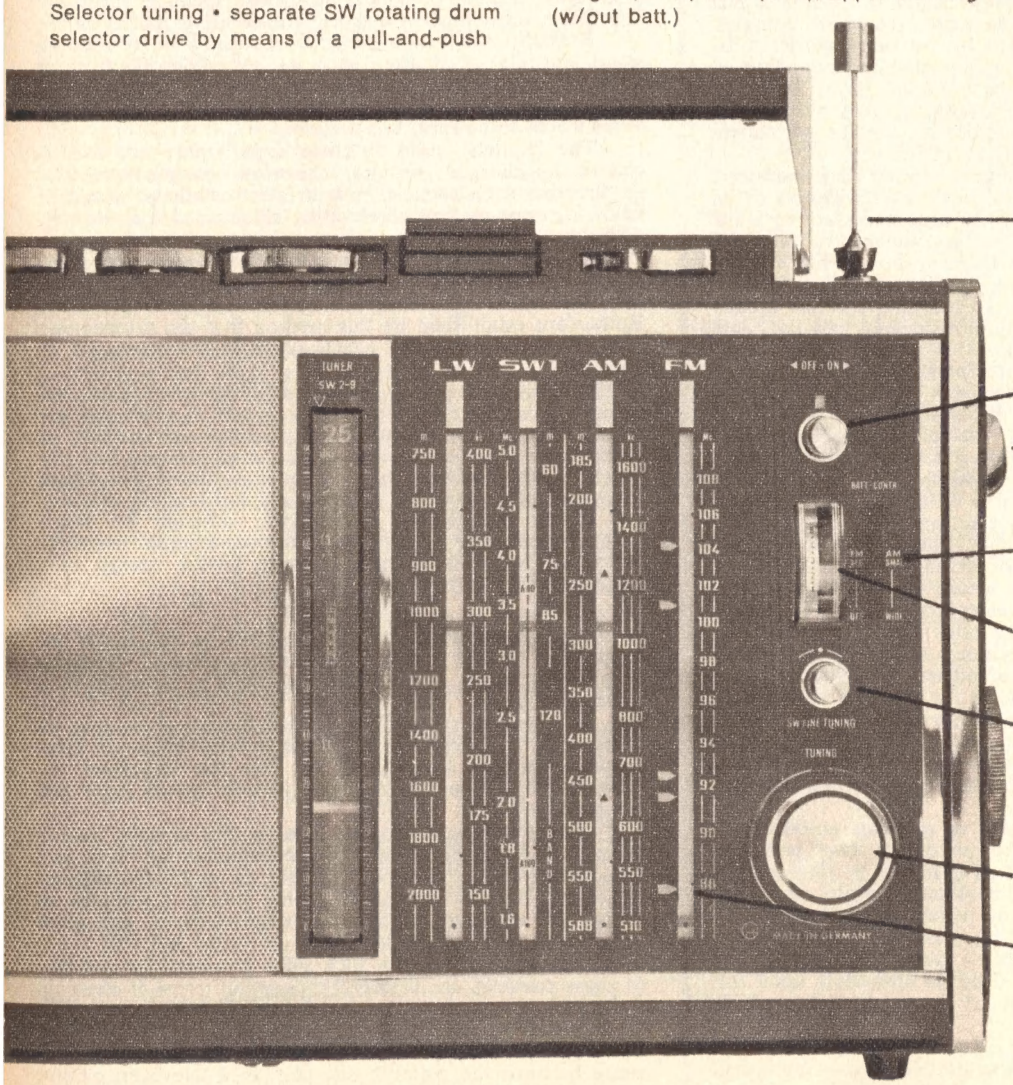

14. MULTI-MATCH telescopic aerial for FM + SW reception.

15. On-Off Switch.

16. Range selector switch (SW Tuner).

17. Switch for AFC on FM, band width selector and battery voltage control.

18. SW fine tuning indicator and battery voltage indicator.

19. SW fine tuning (SW 1 range).

20. Station selector for SW Tuner.

21. Station selector for FM, SW 1, MW (AM) and LW.

22. Slide marks.

GE-P55C

PARTICLE ACCELERATORS—

Enormous sums of money are being spent in the industrialised countries on complex and huge devices known by such esoteric names as "cyclotron," "synchrotron," "synchrocyclotron," "phasatron" and "bevatron." These complex machines are all classifiable under the common name of particle accelerator. The work they do, and how they do it, are explained in this article.

The Need for Particle Accelerators

Man's exploration of the world in which he lives has proceeded in two directions: towards the astronically large, and towards the vanishingly small. Our knowledge has expanded to encompass phenomena which take place on a scale that is vastly different from the immediate experience of our senses. Scientists not only study and theorise about the structure of stars, the motion of our own and other galaxies, the curvature of space, and the possible ways in which our universe has evolved, but also about matter on a smaller and smaller scale. From familiar objects to molecules, then down to the atoms of which molecules are composed; from the structure of the nuclear atom with its orbiting electrons down to the nucleus itself, with its own structure of protons and neutrons and the forces which bind them together, and recently there has even begun to emerge a picture of the individual protons's structure, complex and apparently determined by yet other particles. In the search for a truly fundamental understanding of our world, we are peeling an onion layer by layer, each layer uncovering in a sense another universe — each unexpected and complicated, and as we understand more, each strangely beautiful.

As our understanding of matter has increased with the discovery of ever more subtle aspects of its structure and behavior, it has been necessary to build larger and larger scientific instruments to push on with the search. Just as the astronomer has needed larger optical and radio telescopes to look more deeply into the universe, so the physicist has needed larger accelerators to look more deeply into the heart of matter. The reason for this is that, in a certain sense, the high-energy particles produced by accelerators take the place of ordinary light in acting as a source which illuminates the objects to be studied. To study the structure of the proton, for example, ordinary light cannot be used because its own wave-structure is about one thousand million times too "coarse." For this reason, a different kind of "light" is needed — high-energy electrons — and the higher the energy that is available, the more precisely can the proton's structure be observed.

The second need for accelerators arises from the fact that many of the elementary particles that have been discovered have very brief lives. Many of them change into other forms within a thousand millionth of a second or less. The method used to produce these unstable, shortlived particles for study in the laboratory is to collide an intense high-energy beam of electrons or protons against a target, and then to observe those relatively rare events in which some of the energy of collision is converted into the new particles we wish to study.

The high-energy beams of particles produced by accelerators thus fill the physicist's two principal technical needs: they act as a source of illumination for observing matter on its smallest scale; and they also provide the means by which the rich variety of elementary particles can be created for study in the laboratory. In more general terms, the justification for building accelerators depends ultimately upon the purposes and significance of the research for which they are used.

Extracted from "An Informal History of SLAC," — Stanford Linear Accelerator Centre — published by the Stanford University.

Generally there are two methods of investigation available to any person confronted with an unknown object. The first is to look at it to try to see what it may be. The second is to actuate it or (energise it) to see what it does. From these two sets of observations the nature and composition of the object may usually be determined to some extent.

The atomic nucleus, as an entity, is extremely small and dense. composed of neutrons and protons. The largest known has a diameter of approximately 10^{-14} metre or about one hundred millionth of the wavelength of visible light, so that nuclei cannot be viewed directly and must be investigated by the second method.

The fundamental idea behind most nuclear experiments is to hit the nucleus to see what happens, and deduce its composition and properties from these results, similar to driving a motor car into a wall to see whether it is made of wood, bricks or concrete. Although this type of investigation may at first glance seem to be destructive and useless it has yielded nearly all current knowledge of nuclei and many millions of dollars have been spent in constructing "atom-smashing" or particle accelerating machines.

Basically the action of such machines is to shoot a small particle of matter, such as a proton, neutron or another nucleus, at the nucleus to be studied — the "target nucleus" — and to determine the number and type of particles which come from this collision.

The "bullets" used in these experiments are usually electrically charged particles. The most convenient method of directing such particles is with electrostatic or magnetic fields, so most particle accelerating machines are electrically operated.

If the investigating particle is moving at a low speed and has the same electric charge as the target nucleus it will be deflected away from the target before it strikes. Lord Rutherford established by this method that the nucleus is a positively charged entity which exists at the centre of an atom.

If the speed of the investigating particle is just sufficient to overcome the electrostatic repulsion of the nucleus it may become trapped inside, which yields information on stability; and higher speed particles may succeed in splitting a nucleus without an intermediate absorption, which can yield information on composition and binding energies.

In the investigation of particles, although the words "high speed" and "low speed" are commonly used the important factor is energy. As the kinetic energy of a particle is given by

$$\text{k.e.} = \tfrac{1}{2}\, mv^2,$$

where m is the mass, this is dependent on the speed for fixed mass, but the speed is not the prime factor. (Being hit by a tennis ball at 30mph is not the same as being hit by a motor car at the same speed.)

Also, as the speed of a particle increases so does its mass, (see "Implications of the Relativity Theory," Electronics Australia, January, 1970). This has important results in modern machines where particle speeds approach the speed of light.

One of the most common investigating particles used is the proton which has a mass of approximately 10^{-27}KG, and even at one half of the speed of light, i.e. at 150,000KM/sec the energy is only about 10^{-13} joules, where 4.2 joules of energy are required to raise the temperature of one gram (about one thirtieth of an ounce) of water by 1°C.

To save working with such small numbers the energies of these particles are usually expressed in terms of **electron-volts** (eV), where one electron-volt is the energy acquired by an electron when accelerated from a negatively charged plate to a positively charged plate when the potential difference between the plates is one volt. In a television picture tube with 16,000 volts between cathode and plate each electron reaches the screen with an energy of 16,000eV.

probing the secrets of matter

By L. C. Debnam

Particle energies measured in tens or even thousands of electron-volts are often too small to be useful, and energies of millions of electron-volts are common. One million electron volts is usually given the abbreviation "MeV" and one thousand million electron volts "GeV". The abbreviation "BeV" (one U.S. billion) is also used for one thousand MeV.

One GeV is a high order of energy for a proton, as it then travels at a speed of more than 0.8 of the speed of light and has a mass of nearly twice its rest-mass.

As mentioned earlier, particle accelerating machines are usually electrical, but the early investigations were made with particles emitted from radioactive materials. These particles usually have energies in a fixed range, for example the Radium-226 used by Rutherford emits alpha particles (two protons and two neutrons bonded together) with energies in the range of about 5MeV, and the experimenter has no control over the energy or intensity of the beam of particles.

During the 1920s attempts were made to build electrostatic machines to obtain high energy particles, and although in theory such machines are simple, being effectively cathode ray tubes with proton emitters rather than electron emitters and with the target in place of the screen, the high voltages required were not easy to generate due to insulation requirements.

In 1928 John Cockroft and Ernest Walton devised a voltage multiplier system with which they were able to obtain proton energies of 400,000eV. These protons move at 8,800KM/sec (5,500 miles per second).

The Cockroft-Walton voltage multiplier system is illustrated in figure 1. In principle, it is similar to the voltage doubler systems used in modern electronics apparatus. The voltage from the transformer is used to charge each of the "output" capacitors which are then discharged in series. With this system separation of components is possible and insulation requirements are not as stringent as with tranformers.

Insulation requirements can also cause troubles in the accelerating tube itself, so a system of guard rings has been devised to keep the electric field uniform along the length of the tube. These internal guard rings are connected directly to a set of corona discharge rings outside the tube (figure 2). If the potential between two adjacent discharge rings rises above a certain level, corona discharge may occur dependent on physical spacing. Due to the poor regulation of such a system, this discharge reduces the potential between these rings thus increasing the potential between others. This results in an overall electric field which is reasonably uniform along the length of the tube.

Aerial view of the Stanford Linear Accelerator Centre (SLAC). This huge complex occupies 480 acres of Stanford University's land. *(See page 11.)*

After the Cockroft-Walton voltage multiplier system, the next significant advance in the production of high voltages was the Van de Graaff generator devised by Robert Jemison Van de Graaff in the 1930s. Basically the Van de Graaff Generator consists of a moving belt which transfers charges to a storage capacitor, for example a sphere, thus building up a high potential on the sphere. With even simple Van de Graaff generators it is possible to generate voltages in excess of one million but the upper limit is about 10MeV (figure 3).

The Van de Graaff generator is now the most common method used for generating high voltages, but obviously proton energies higher than 10MeV are not practicable by direct acceleration as in the accelerating tube of figure 2. A variation of this system is the tandem generator such as the one in use at the Australian National University.

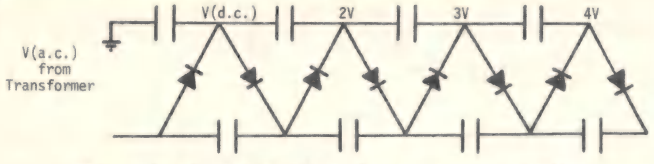

Figure 1. The Cockcroft-Walton voltage multiplier.

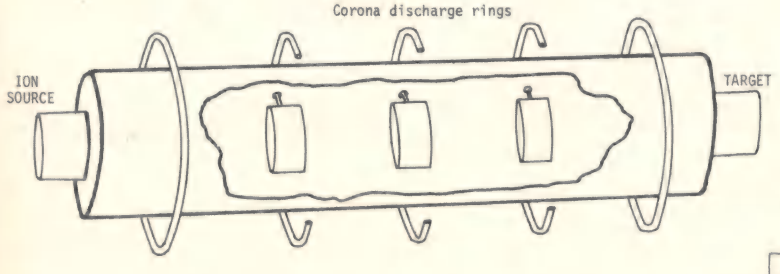

Figure 2. The accelerator tube.

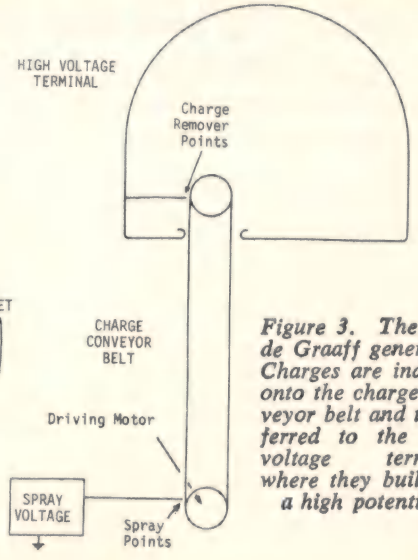

Figure 3. The Van de Graaff generator. Charges are induced onto the charge conveyor belt and transferred to the high voltage terminal where they build up a high potential.

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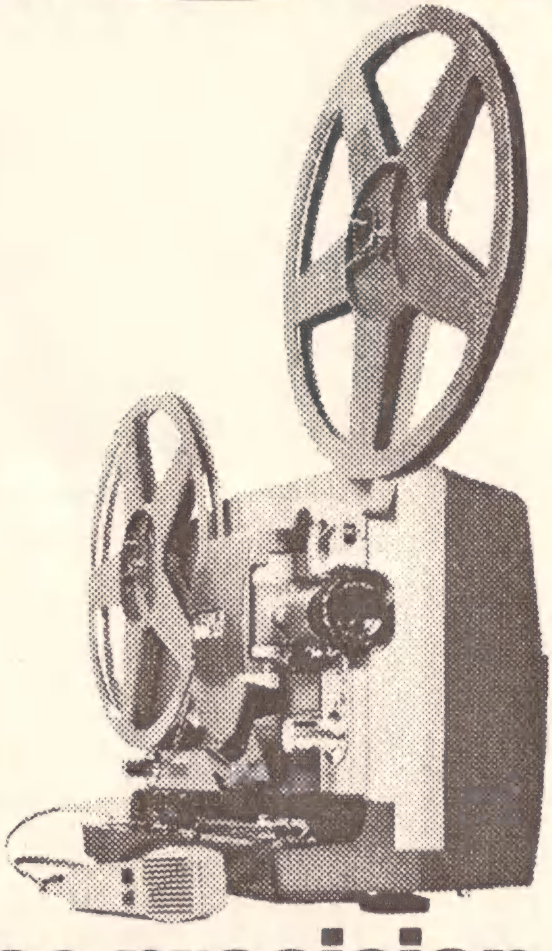

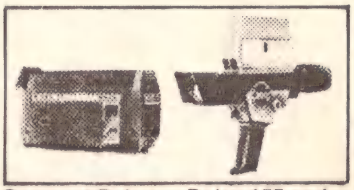

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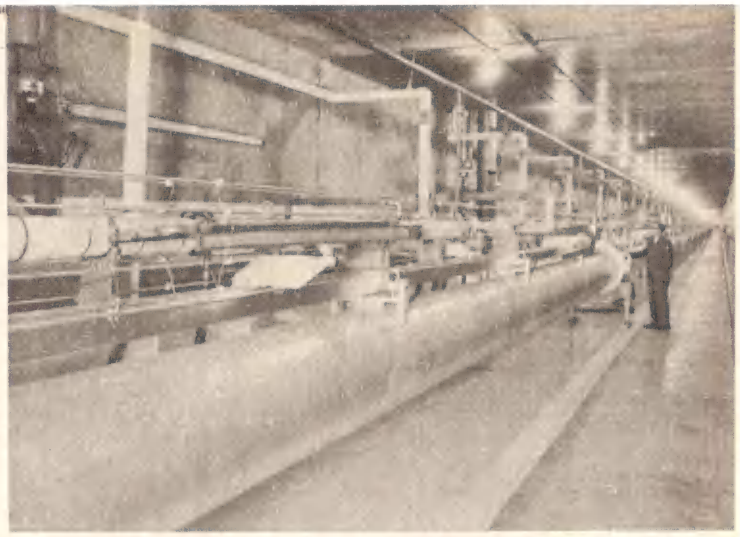
STANFORD LINEAR ACCELERATOR CENTRE

Built at a cost of $US114 million, and occupying an area of 480 acres, the Stanford Linear Accelerator Centre (SLAC) at Stanford University, California, is said to be the largest of its type in the world.

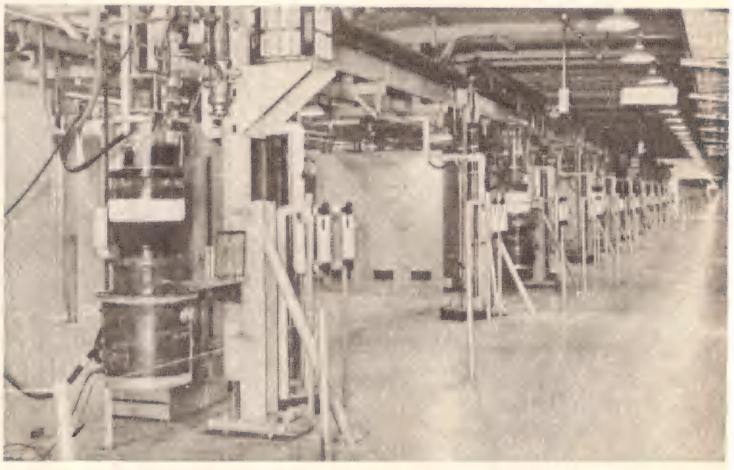
SLAC has a two-mile linear electron accelerator which produces an intense controlled beam of high-energy electrons, with energies as high as 20,000MeV. This high energy provides very high precision, or resolving power in measuring the structure of elementary particles; and the energy carried by the electrons is sufficient to create for study all of the great variety of particles or particle-like states (some 200 in all) that have been discovered in nature till now.

The accelerating structure itself is a high-precision copper pipe 4 inches in diameter and 10,000 feet long, which is housed in a tunnel under a radiation shield consisting of 25 feet of earth. Above this tunnel, at ground level, there is a two-mile-long building, the Klystron Gallery, which houses 240 high-frequency power valves similar to those used in radar sets and in microwave communications. These klystron power sources, spaced out at 40-foot intervals along the gallery, are programmed to deliver repeated bursts of intense microwave radiation into the accelerator pipe. The timing is such that electrons injected into one end of the machine are "carried" along in the pipe on the accelerating crest of the radio waves for the full two-mile journey. This accelerating process increases the energy of the electrons to as much as 20,000MeV. Since electrons have so little mass, their speed increases to very nearly the velocity of light after only a few feet of acceleration. This means that the continuing increase in energy achieved over the full 10,000 feet has only a small additional effect on the electron's velocity, whereas its mass is increased some 40,000 times.

At the end of the accelerator, the high-energy electron beam enters a branching array of large bending and focusing magnets called the "beam switchyard," which is used to direct specified patterns of beam pulses to any of the several widely separated experimental areas further downstream. The target points for the beam are located within heavily shielded buildings, and the particle events to be studied are detected and analysed by such apparatus as spectrometers and electronic counters, spark chambers, and bubble chambers.



Part of the interior of the two-mile long klystron gallery. A 24MW klystron hangs every 40ft. Mounted on the shelf behind the first klystron in the picture is one of the 120 ion-getter vacuum pumps used to continuously maintain a high vacuum in the waveguide system.



Part of the interior of the subsurface accelerator housing. The waveguide is the smaller of the two tubes (at head height) and the larger tube is a 2ft diameter round aluminium girder which supports the waveguide, and serves as a passage for a light beam used as an alignment reference.

The principle of the tandem generator is illustrated in figure 4. Negative ions are produced at the ion source and are attracted toward the positive potential of the stripping section. In the stripping section the negative ions are passed through a stream of hydrogen which strips some electrons from them, causing them to have a positive charge. Their momentum causes them to leave the stripping section toward the target and because they are now positively charged they are attracted towards the final electrode which is negative. The voltage which creates the positive potential at the stripping section therefore has a double (tandem) action, first attracting particles then repelling them.

In addition to using the supply voltage twice, thus effectively obtaining twice the energy from the same supply, both the ion source and the target may be grounded, thus making the machine safer to operate. After reaching the final electrode, particles of the required energy are magnetically deflected by the analysing magnets to the target. Tandem generators have been built with proton energy ranges up to 20MeV and beam currents of the order of 10 microamperes.

So far the types of particle accelerators discussed have been the theoretically simple types. These are generally known as "direct current accellerators" because the charged particles are accelerated by application of a steady electric field.

It was early realised that there is a practical limit to the energies available from DC accelerators; for example a cascade generator of the Cockroft-Walton type requires a cube with side lengths of about 12 metres (40ft) for one million volts. The tank for the 20MeV tandem generator mentioned earlier is 27 metres long and 6 metres diameter — at a corresponding cost of $2.5 million.

In the early 1930s attempts were matde to build accelerators in which the speeding proton moved through a succession of cylinders, in each one of which it was accelerated further but difficulties arose in timing the switching on and off of the potentials to accelerate the proton forward and not backward.

In 1931 a new principle of acceleration was introduced by Earnest Orlando Lawrence and Stanley Livingstone at the University of California, Berkeley. This involved moving the proton across a magnetic field so that it travelled in a curved path, and the instrument was thus named the "cyclotron."

The cyclotron principle is illustrated in figure 5. It consists of a pair of metal half-cylinders (referred to as "Dees" because of their shape) slightly separated from each other. An ion source is located near the mid-point of the gap between the Dees, which are enclosed in an evacuated chamber, placed between the poles of a large electromagnet, and connected to a high frequency alternating voltage.

When a proton is emitted from the ion source, it is attracted toward the Dee which is negative at that time. As the proton moves, its path is changed

to a circular motion by the magnetic field. The frequency of the alternating voltage is chosen so that when the proton has completed one half circle, it is attracted across the gap to the other Dee. This process continues, and the proton moves in a spiral path until it eventually reaches the circumference of the Dees. It is then deflected toward the target by an auxiliary set of magnets or electrostatic deflection plates.

The first cyclotron, built in 1931, was less than 1ft in diameter, yet was capable of producting protons with energies of nearly 1.25MeV. By 1939 a larger version with a diameter of 5ft was producing 20MeV protons at Berkeley.

At energies above about 15-20MeV the relativistic increase of mass with velocity begins to have some effect and it is found that this affects the action of the cyclotron. The cyclotron frequency is based on the assumption that the increased energy of the particle is entirely represented by increased speed, but at 20MeV only 94 per cent of the energy is in the form of speed and the proton speed tends to alternately reduce and increase until it reaches a steady speed. It seemed in 1939 that the upper limit of energies obtained by the cyclotron would be limited to 20MeV.

In 1944, however, the Russian scientist V. I. Veksler designed a modified cyclotron in which the frequency of the alternating voltage is decreased as the proton speed is increased so that the motion of the proton and the application of the electric fields remain in phase. This device was known as the "frequency modulated cyclotron" or "synchrocyclotron" and such devices are now being used to produce proton energies up to 800MeV.

A variation of the synchrocyclotron idea uses shaped magnetic pole-pieces so designed that the magnetic field strength is maximum at the centre and decreases toward the circumference of the Dees. The effect of this is to vary the circular path of the protons so that they complete their half-turn in phase with the applied alternating voltage.

Some synchrocyclotrons combine the two methods of variable frequency and contoured magnetic fields, usually operating with only one Dee, the alternating voltage being applied between this Dee and the outer case of the machine.

Some idea of the specifications involved in synchrocyclotrons may be obtained by considering the specifications of the machine at the University of Chicago. In this the pole pieces are 170in (4.2 metres) diameter and the magnetic field decreases from 1.86 Tesla at the centre to 1.76 Tesla at a radius of 76 inches. (The magnetic field strength of common "handy" magnets is about 0.1-0.2 Tesla.) The applied alternating voltage is between 10KV and 30KV, varying between 28.6MHz and 18MHz with a repetion rate of 60 per second, to produce proton energies of 450MeV. The RF is supplied by a valve oscillator circuit in which the tuning capacitor is motor driven.

The major disadvantage of the synchrocyclotron is that the proton beam arrives at the target in pulses instead of a steady stream, due to the variations in frequency required to obtain these high energies.

Also as the particles move outward

in a spiral a practical limit to upper energies is set by the size of magnet which can be constructed.

Protons and heavier ions are normally used as projectiles in nuclear experiments because their mass is comparable in size to the mass of the nuclear target, at the least it is only about one three hundredth of the mass of the target. Occasionally electrons may be used, but only in special cases, since the mass of an electron is only 1/1836th of the mass of a proton, (although their charges are equal but of opposite polarity).

Electrons may be accelerated in DC accelerators in the same way as protons but again there are limitations to the energy.

In 1940, D. W. Kerst constructed a machine knowns as the "Betatron" or "electron induction accelerator" in which electrons emitted from a filament are kept in motion in a circular path and accelerated by increasing the magnetic field intensity while they are attracted toward a target (figure 6). Electron energies of 100MeV are readily obtained by this method, the electrons making 250,000 revolutions in 1/240th of a second. When the electrons are required to move out of orbit to strike the target a capacitor is discharged through a second magnet coil to alter the magnetic field.

A variation of the Betatron is a device known as the "Synchrotron" which is capable of accelerating electrons up to energies of 300MeV.

In the Synchrotron, a normal Betatron tube is internally coated with silver on a small section to form a metallic cavity broken into two parts. A high frequency voltage is applied to this cavity, synchronised with the electrons so that they are accelerated through this section of the tube.

When the electrons are injected at the start of the process the device acts as a Betratron for a few microseconds until the electrons achieve an energy of about 2MeV, then the HF field is applied. The HF field remains on while the magnetic field increases until the required energy is achieved by the electrons; the HF field is then switched off and the magnetic field altered, as in the Betatron, to deflect the electrons to the target.

In the early 1950s the Synchrotron method was successfully used to accelerate protons, and most high-energy machines are now in the form of Proton Synchrotrons. The names given to Proton Synchrotrons are varied. A 2.3GeV machine built at Brookhaven National Laboratories (New York State) in 1952 was named the "Cosmotron" because the particle energies attainable are close to energies of cosmic particles. A 6GeV device at Berkelev (California) is called the "Bevatron" (GeV = BeV), and a 10GeV machine at Dubna (U.S.S.R.) is called the "Phasatron."

The protons to be accelerated in the Proton Synchrotron are first accelerated in some other machine to energies of about 10MeV and then introduced to the Synchrotron tube.

The theoretically most complicated particle accelerators are of the "travelling-wave" type where electric fields travelling at or near the speed of light are used to "carry" charged particles. Although attempts had been made to make these in the early 1930s, they did

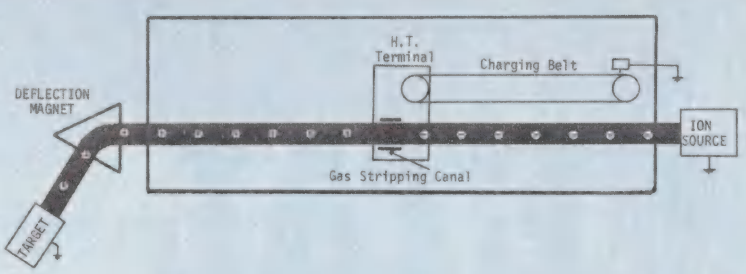


Figure 4. Diagram to show the principle of operation of a tandem generator. The deflection magnet (or analysing magnet) deflects ions of the correct energy toward the target.

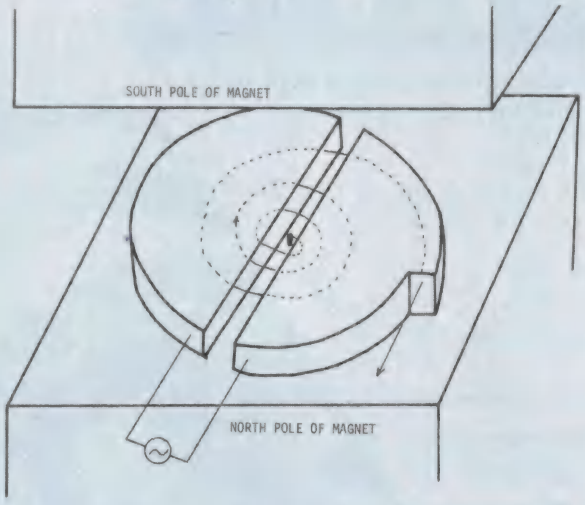


Figure 5. The Cyclotron. Note the spiral path taken by the accelerated particles.

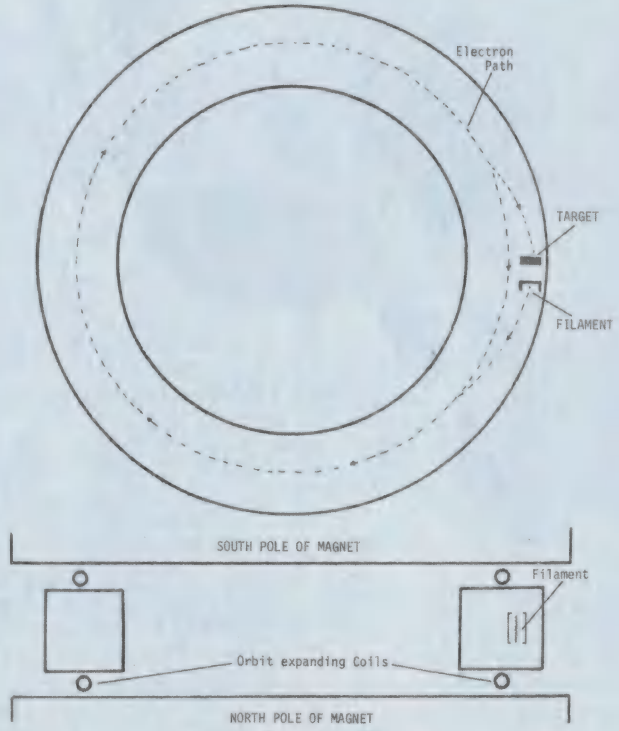


Figure 6. Plan view and side view of a Betatron.

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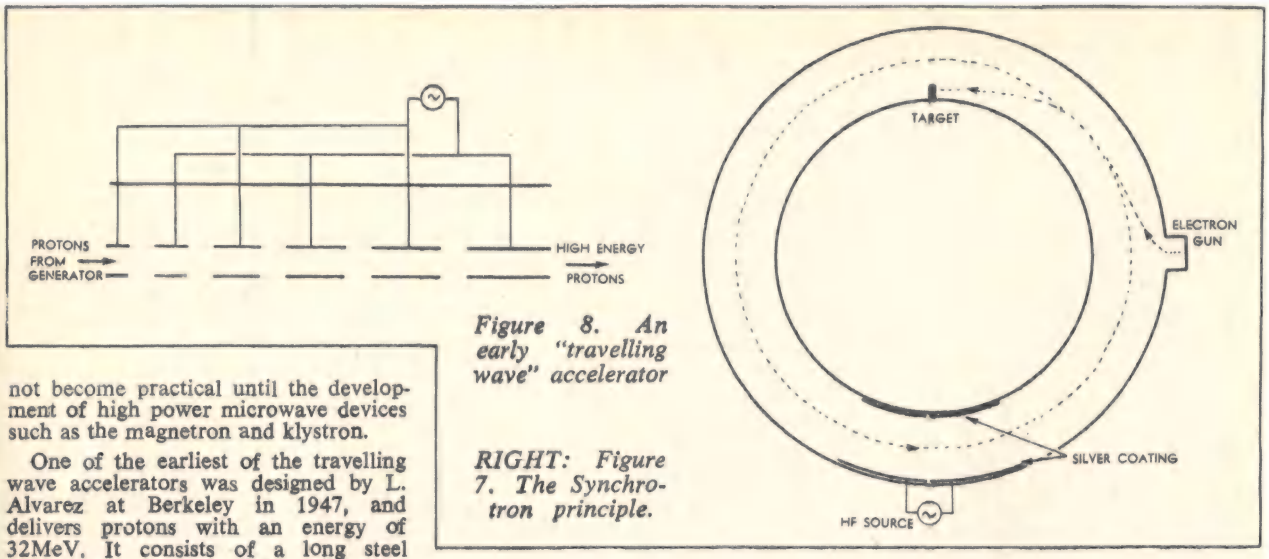


Figure 8. An early "travelling wave" accelerator

RIGHT: Figure 7. The Synchrotron principle.

not become practical until the development of high power microwave devices such as the magnetron and klystron.

One of the earliest of the travelling wave accelerators was designed by L. Alvarez at Berkeley in 1947, and delivers protons with an energy of 32MeV. It consists of a long steel vacuum chamber containing a 12-sided copper tube, 12 metres long and 1 metre diameter, which acts as a resonant cavity at 202.5MHz.

Protons at 4MeV are injected along the axis of the resonant cavity and pass through a set of 46 drift-tubes which shield the protons from the HF electric field travelling down the tube during the time that the phase of the wave is such as to produce a negative acceleration of the protons.

As the velocity of the protons increases, the length of the drift tubes must also increase so that the proton and electric field remain in phase. In this machine the lengths of the drift tubes vary from 11cm to 30cm.

Power to the cavity is supplied from 26 oscillators delivering a peak power of 2.15MW in pulses of 0.3 millisecond duration at a repetition rate of 15 per second.

Many electron travelling wave accelerators are currently operating in the energy range 10 to 1000MeV. One of the largest is in operation at Stanford University (U.S.A.) which accelerates electrons to 20GeV. In this, the accelerator tube is 3050 metres (nearly two miles) long, and operates at a frequency of 2856MHz. The tube in this acts as a waveguide (TM_{01} mode) and has a diameter of 8.2cm.

Travelling wave accelerators are often referred to as "linacs" (LINear ACcelerators) as they accelerate the particles along straightline paths.

What will be the largest particle accelerator in the world, designed to accelerate protons in four stages, is currently being built in the U.S.A. at the National Accelerator Laboratory, Batavia, Illinois. Initially it will supply protons at energies of 200GeV, and eventually at 400GeV. The accelerator (estimated cost $US250-million) is expected to come into service mid-1972.

The first stage consists of a 750KV Cockroft-Walton voltage multiplier which supplies protons to a 200MeV travelling wave accelerator 150 metres long. The 200MeV protons are then introduced to an 8GeV booster synchrotron of 75-metre radius before being fed to the main ring synchrotron of 1KM radius which accelerates the particles to their final energies. The beam power of this new accelerator is expected to be 480KW, delivering protons at a rate of more than 10 million million per second.

Although energies of 400GeV are expected to be attained in man-made machines this appears insignificant when compared with some cosmic particles which reach the Earth.

Most cosmic particles have energies in the lower GeV range but about one in each million million has an energy of 5,000,000,000GeV.

Such a particle, travelling virtually at the speed of light, has a mass of 10 thousand million times its rest mass and its kinetic energy is roughly equivalent to the kinetic energy of one ounce of matter travelling at 20 miles per hour. ■

AUTOMATED PRODUCTION OF SEMICONDUCTORS

A new system which is expected to lead eventually to fully automated production of semiconductor devices has been announced in Japan by Hitachi Ltd.

The system uses a highly complex ion implanter device, for which Hitachi has just completed a prototype. Hitachi developed the machine with the aid of subsidies from the Research Development Corporation of Japan. It is used to ionise and implant impurities which determine the electrical properties of semiconductors. Mass production of diodes, transistors and MOS field effect transistors has already been successfully carried out on a trial basis with the new machine.

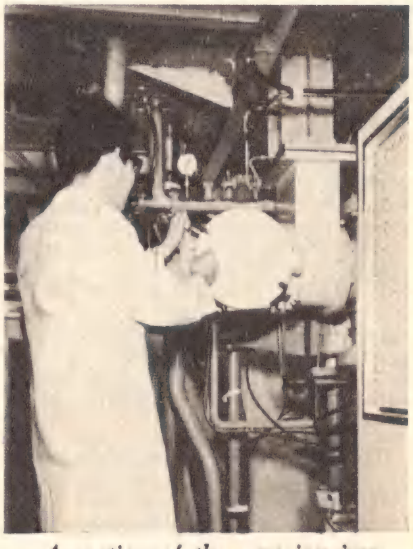
At present, the thermal diffusion process is most commonly employed in the manufacture of semiconductor devices. However, this process tends to cause uneven distribution of doping impurities and permits no automatic production, because quantitative monitoring of impurities is impossible. By ion implantation, such impurities as boron and phosphorus are ionised, accelerated by a high voltage system (200KV) and implanted into silicon substrates.

Ion beams can be implanted simultaneously into a maximum of nine silicon wafers, and processing of a large number of semiconductors with uniform characteristics is possible. A computer controlled automatic production technique is envisaged, and since direct measurement and control of the ion beam is possible, the amount of impurities can be monitored during processing of the silicon slices.

Other advantages claimed for the new system are:

Adjustment of the ion source and accelerator voltage can be undertaken easily and safely at ground potential.

Processing can be carried out at relatively low temperatures, ranging between 400 and 900 degrees C, compared with the 1000 to 1200 degrees C required for the thermal diffusion process. ■



A section of the new ion implanter machine installed at the Hitachi works, where it has already been used for pilot runs for the mass production of semiconductor devices.

MEDICAL APPLICATIONS

The effects of electromagnetic radiation on biological tissue has been researched since the turn of the century, to determine whether it could be applied in healing and diagnosis. The development of the laser has opened up new fields of possibilities, and a great deal of interest has centred on its possible use in medicine.

Before describing the present and possible future uses of lasers in the medical and biological fields, it is useful to examine what differences exist between laser radiation and other forms of electromagnetic radiation.

Laser emissions are said to be coherent over a distance called the coherence length. By this we mean that as the wave progresses away from its source, there is a defined relationship between the different spatial co-ordinates of the wavefront for a distance from the source. Beyond this distance (the coherence length) the wavefront becomes so distorted that it cannot be defined.

The coherence properties of laser emissions make it possible to use two beams to interfere with each other over distances far greater than have been achieved before. When light is scattered by an object and photographed using conventional photography all phase information, that is, the difference in time of the arrival of the light waves, is lost. However, by causing interference between the scattered and non-scattered radiation, then information about both intensity and phase can be stored on a photographic plate — called a hologram. Such information enables three dimensional pictures to be obtained which may have medical applications.

The most vulnerable part of the body to laser damage is the eye and because of this a great deal of work has been done to measure the eye's absorptive properties to different wavelengths. Its ability to focus light on the retina makes it very susceptible to laser damage, but at the same time makes it possible to use lasers to repair detached retinas.

Retinal damage results from injury, degenerative change or disease and early treatment can prevent blindness. Due to degenerative or shock processes, the retina becomes detached from the back of the eye and degenerates in a matter of weeks. By draining the sub-retinal fluid the detachment can be flattened and the retina re-attached to the choroid, the coloured coat at the rear of the eye. In the past this delicate operation has been done with diathermic cryoprobes or by the irradiation of the eye with a 2KW xenon arc lamp. In the later case, anasthesia was necessary to prevent the eye from moving. If a pulsed laser is used anaesthesia is unnecessary and the patient suffers no discomfort. A solid state ruby laser can, with ease, be incorporated into a conventional ophthalmoscope and many hospitals in the U.K. are now equipped with these instruments.

Any new source of radiation tends to be exploited for

LASERS AND COHERENT LIGHT

All forms of light are caused by the emission of photons brought about by changes in energy levels within atoms. Electrons orbit around the nucleus within an atom. There is a maximum number of electrons which can be accommodated within any particular orbit, so the more electrons there are within atoms, the more orbit paths are required by the electrons. The position of any orbit path within an atom is referred to as an energy level. An electron orbiting within its normal energy level is said to be in its "ground state." However, by exciting the electrons, and giving them additional energy, they can be made to move to an orbit further out, so that they take up a higher energy level.

The energy applied to achieve this can be of various forms. It can be the movement of electrons through an electric current flow; friction; direct heating; or, as in the case of some lasers, by light. The energy so applied causes the electrons to take up a higher energy level for a short time then, as they drop back to their original energy level, they give up their extra energy in the form of light, by the emission of photons. A photon is a quantity of light radiation, whose frequency and colour are determined by the amount of energy acquired originally by the electron which emits the photon.

The application of energy to cause electrons to take up a higher energy level is known as "pumping." If pumping is at a sufficiently high level, the case arises where more electrons are in a higher energy level than in the ground state — this is the condition known as "population inversion." This condition is very favourable for lasing to occur, since for effective lasing action, a large number of electrons in a higher energy level is essential.

We can now consider what takes place when lasing occurs. As has previously been explained, light is caused by the emission of photons when electrons drop back to the ground state from a higher energy level. Under conditions of population inversion, the first few photons emitted collide with other electrons in a higher energy state and about to drop back to their normal level. These collisions precipitate the return to the lower level, so that more photons are emitted. The most significant factor about this action is that both the original photons and those subsequently released by the collisions are in phase.

Because of the high speed at which they move (the speed of light) photons will move out of the material in which they originate before any significant cascading action can occur, thus under normal conditions no avalanche condition can build up. To prevent this from occurring, lasers have an optical and reflecting system which acts as a resonator at a particular light frequency. In the first ruby lasers, the end faces of the ruby rod were polished optically flat and parallel to a high degree of accuracy, then silvered. One end was completely silvered for maximum reflection, the other end only partially silvered, so that a small amount of light escaped, while the photons of the remaining light were reflected in each cycle to keep the process going by more collisions and more release of photons.

More recently, a system known as "Q switching" has been developed, which allows pulses to be precisely controlled, and thereby allowing higher power levels to be attained in the laser beam. The following description of Q switching appeared in "Electronics" (Vol. 38, No. 21):

"A Q switch prevents lasing momentarily by inhibiting a laser's resonance until the laser has stored up a large amount of energy. This rapid change in the Q, or quality factor, is achieved by inserting a suppressor into the resonant cavity in which the laser's energy is built up. Introduction of the Q switch causes optical losses, which decreases the laser's medium's Q momentarily. When the switch cannot absorb any more light, it opens (becomes transparent) restoring the Q factor to its normal level and releasing the pent-up energy all at once."

FOR LASERS

By Dr D. W. GOODWIN

Physics Dept., University of York

tumour therapy and already a great deal of useful work has been carried out in this field. Inevitably, this has centred on initial therapeutic studies. Attempts have been made in the U.K. to treat diseased growths in the eye using ruby lasers and in two cases out of five, progressive necrosis (dying off) was observed. Up to now no survival figures are available but there is hope that some growths will respond well to treatment with laser light. This work has been carried out in association with International Research and Development (IRD) Ltd. of Newcastle upon Tyne. How or why necrosis occurs after radiation is not known and research has started to find out the fundamental processes which may lead to it.

It is thought that an ultra-violet laser may be used as a diagnostic tool. Protein fluorescence tracing has been known for some time and some proteins and vitamins can be preferentially absorbed by carcinomas (cancers).

The pigment porphoryn has been used as a diagnostic aid in some preliminary tests on animals, but unfortunately, chemical decomposition of the porphoryn giving toxic by-products was found after it had been exposed to visible radiation. Cancers of the gullet have been detected by using a suitable light pipe. Fluorescence tracing using other proteins, preferentially absorbed by certain carcinomas, offers many possibilities. For instance, no studies of fluorescence decay times of such trace proteins have been carried out in detail and it is well known that decay times of such systems, though very short, are dependent on their co-ordination with other systems.

By using a form of Q switching (see panel, opposite page) very short-duration high-energy pulses can now be achieved. Using these methods, very short pulses have been observed, as short as 5×10^{-14}sec. and with peak powers in excess of 600GW. Pulses as short as 10^{-9}sec. are now easily realised, and should prove of great use in fluorescence tracing studies. The Q switch may use electro-optical methods, or a rotating prism, or may consist of a simple cell containing a bleachable dye solution, which normally absorbs light, but become transparent when illuminated by high-intensity light.

Malignant cells in cervical smears might be detected with fluorescence tracing techniques which are at present seen by direct microscopic observation, or by light scattering techniques. Such large cells, as malignant cells are assumed to be, can be found by a tedious microscopic search or by the large angle scattering of a laser beam caused by a large proportion of large cells. There is, however, some doubt statistically about such tests. If it proves possible to absorb a suitable fluorescent protein into a malignant cervical cell then such techniques could improve detection and from this it might be possible to develop an automated method. The effect of excess ultra-violet radiation on the skin is known to produce melanomas (malignant pigmented skin cancers) in certain cases. Some of these have been successfully treated by irradiation with a laser. There appear to be reversible photo-chemical processes and more detailed studies are needed. Dr Lawrence of the Medical Research Council's Burns Unit in Birmingham found that after irradiation with a ruby laser there was some damage produced, in this instance, by the thermal processes, but there is evidence of other effects when the melanomas are irradiated with higher frequencies.

Tattoos can possibly be removed by laser. The low reflectivity tattoo mark will absorb preferentially the laser radiation and will therefore be ablated. However, the infinite variety of pigments used presents difficulties and it is already becoming apparent that more detailed studies are necessary before this can become an established technique.

A laser retina welder developed in the U.S.A. by Honeywell Inc. The light beam is aimed by the ophthalmic type instrument the doctor is holding to his eye.

Following on these studies, the treatment of skin blemishes such as birthmarks and other types of angiomas has been carried out with some success. These blemishes are caused by the clumping of blood vessels just below the skin. Because of the high optical absorption of blood such blood vessels can be broken down. Following treatment, the angioma adopts skin colouration similar to that of neighbouring areas.

Several other applications have appeared. For instance, the high power densities which have been realised, coupled with the small spot size, make the laser a useful surgical tool for producing clean incisions.

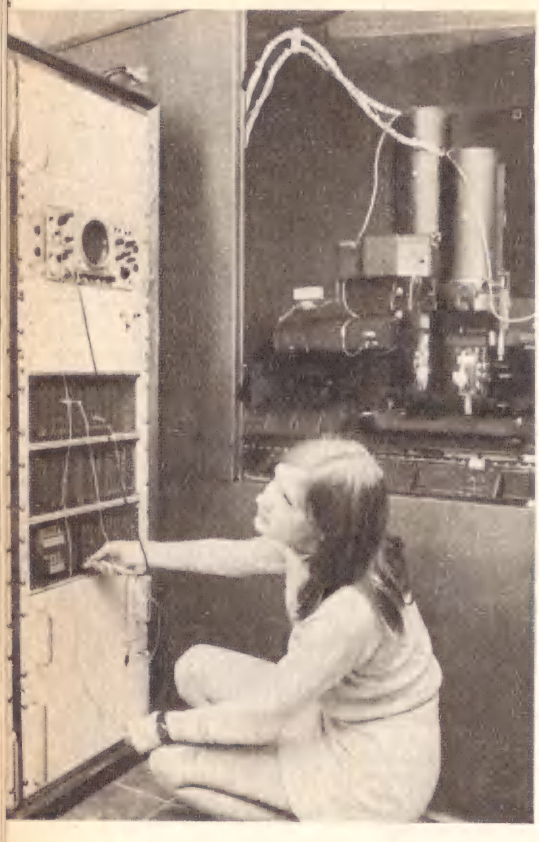
The high absorption coefficient of blood lends the possibility of destroying blood clots and hence preventing thrombosis. Blood clots can be generated artificially by laser damage of blood vessels and studies of anti-coagulants carried out. The destruction of kidney stones using a combined laser-fibre optic system has also been suggested.

It would be useful if three dimensional pictures of the various parts of the human body could be produced without causing tissue or cell damage. By using ultrasonic holography this may be possible.

When a normal photograph is taken, phase information is lost. However, as mentioned earlier, this can be recovered by using interference techniques. Three dimensional images obtained and ultrasonic holograms have been generated using conventional quartz transducers and either a scanning detector or an array. The intensity pattern is recorded on an oscillograph and photographed, the negative then being illuminated by a laser beam which gives a three dimensional reconstruction of the object.

Three dimensional pictures of human embryos have been made in collaboration with the Army Weapons Research Establishment (A.W.R.E.) at Aldermaston, in Hertfordshire, but unfortunately considerable blurring was encountered due to the non-uniform refractive index of body tissues. This may prove a serious limitation in detailed internal studies but the initial results have proved interesting and may offer the possibility of outdating conventional X-ray technique.

The laser has been applied to many medical problems in the last five or six years and the approach has, to date, been of an empirical nature. It is now apparent that much quantitative study needs to be carried out on the interaction between laser radiations of all wavelengths and the human system. There is little doubt that the laser will play an important role in medical treatment and diagnosis in the future. ■



GALAXY COUNTS THE STARS

Vast new possibilities for the study of the Universe have been opened up with the coming into service in Edinburgh, Scotland, of a new system which automatically detects and classifies stars whose images are recorded photographically.

The system is called Galaxy (General Automatic Luminosity and XY). The idea was conceived at the Observatory and the system was developed and manufactured by the small Scottish company Faul-Coradi. Basically, it is an automatic mapping and measuring machine, the operation of which is somewhat similar to that of the scanning electron microscope. Its output is fed to an Elliott 4130 computer for analysis.

The basic problem in some fields of astronomical research has been one of sheer numbers — there are 200,000 million stars in our galaxy alone, but so far only tens of thousands have had their positions and brightness measured precisely and even approximate measurements cover mere hundreds of thousands of stars. Now Galaxy is used to measure accurately and automatically the positions and brightness of stars at the rate of a thousand an hour.

Galaxy has four main features; a cathode ray tube to scan photographic plates with a spot of light to find the star images and measure their sizes and densities, a precise mechanical carriage to hold and position the plate with an accuracy better than one micron (a millionth of a metre), a system for measuring the carriage position to a micron, and a computer-type electronic system to control the operations.

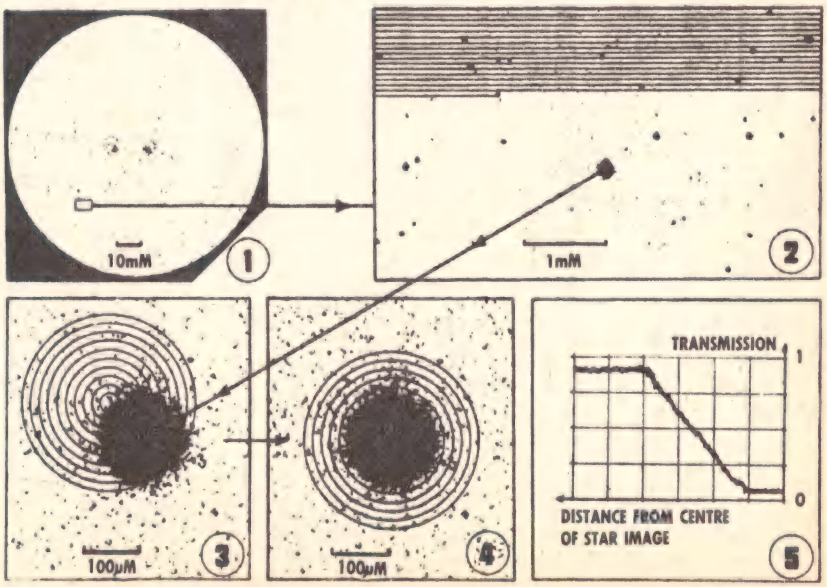
The first stage of the machine's operations is the linear scanning of a section of a star plate, taken through the Observatory's 16-inch Schmidt telescope, by a small spot of light, usually 16 microns across. The light passes through the plate and is measured by a photoelectric cell, but when it passes over a star image (a dark spot, as a negative plate is used) the image is detected by the cell as a reduction in brightness and its position recorded. With a 16-micron size spot a plate can be covered at a rate of 30 square millimetres per minute, 10,000 stars being found and recorded in an hour.

The star plate is then scanned for a second time, but at a greater magnification. The carriage carrying the plate puts each star in turn under the scanner and a spot of light now only one micron across is scanned in a spiral pattern over the image. The carriage position is measured and in this way the position (the XY co-ordinates) of the image determined in units of a micron. At the same time the amounts of light passing through different parts of the image are measured and examined by the electronic control system to determine the structure of the image by comparing it with 1024 standard profiles which Galaxy retains in a core store. The measurements of position and brightness are coded on eight-channel punch tape at a rate of a thousand stars an hour for subsequent analysis by the Observatory's Elliott 4130 computer.

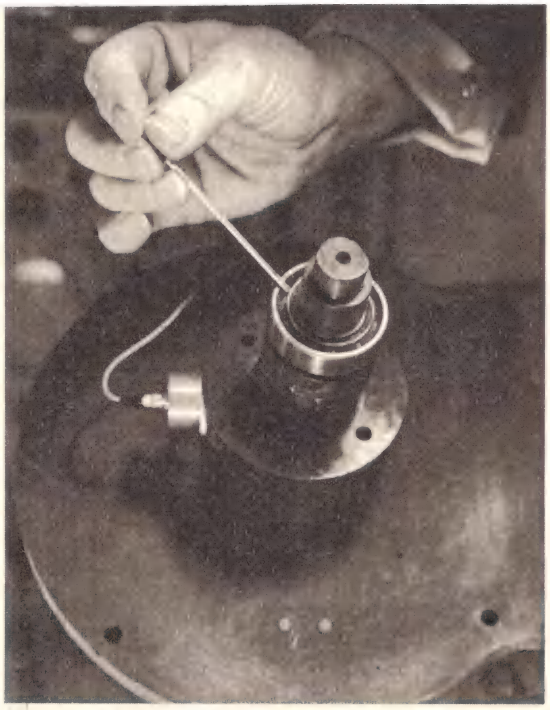
During intensive trials the machine exceeded expectations; positions were measured to a precision of half a micron instead of the specified one micron, and the image sizes were measured with a precision 20 per cent better than specified. But the great value of the Galaxy machine lies in its ability to make high speed measurements. In one recent demonstration of its effectiveness it examined an area in the constellation of Pegasus and in a single night discovered 1,103 "baby stars" (stars aged less than 28 million years) where before only 12 were known.

It is anticipated that Galaxy may eventually find applications in other fields — it has already been suggested that it will find application in molecular biology, genetics and medicine. Those responsible for its creation believe it could be used in conjunction with a microscope in any fields which involve the recognition of large numbers of complicated patterns; for example, the study of living cells. ■

ABOVE: The Galaxy equipment (in the background) with associated monitoring equipment.



RIGHT: Stages in the operation of Galaxy. A photographic negative (1) has up to 40,000 stars recorded as black images. The area within the rectangle is selected for measurement. The enlarged image (2) is scanned by Galaxy. When scanning is completed, individual star images, greatly enlarged, are scanned spirally (3). The image is then automatically centred in the spiral scan (4) and measured. The outline of the star is displayed on an oscilloscope during the measuring process (5).



A faulty bearing, wired for sound, sings a worried song.

THE SOUNDS OF SILENCE

In the Boeing Company's aerospace laboratories, a system which makes recordings of supersonic sounds and slows them down so that they are audible is being used to predict mechanical and electrical failures.

By Wes Robinson

Perhaps fortunately, nature provided man with only limited hearing — roughly in the region of sound vibrating at frequencies between 16 to 20,000Hz. Thus man does not hear the rattle of air molecules bumping into each other in a breeze or the rumble of a growing tree. Yet there are such sounds, in fact a complex universe of sounds above and below man's range of hearing. It is a wonder more human eavesdropping has not taken place in these supposedly silent regions.

Work now under way in Boeing's aerospace laboratories clearly indicates that tuning in on this cacophony of silence may be of tremendous benefit to both man and machine. The Boeing work is the brainchild of Harvey Balderston, a research specialist in Boeing's failure analysis laboratory. Balderston reasoned that it might be possible to hear tiny mechanical defects if some way could be found to screen out unwanted noise.

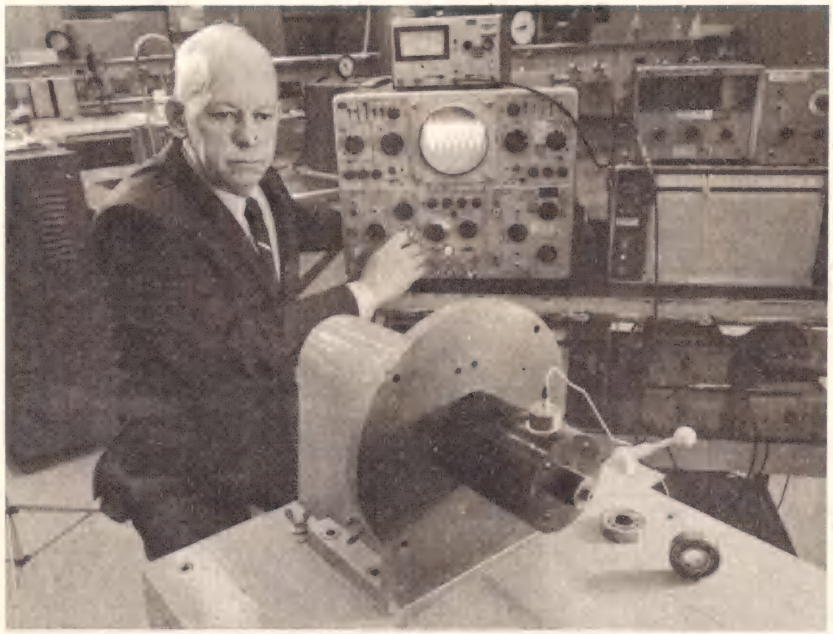
By recording only extremely high frequencies and then slowing them down to the range of human hearing, Balderston did screen out unwanted noise. A bearing with only a tiny scratch on its surface sounds like a lively xylophone solo when recorded and played back at a slow speed. A worn hydraulic valve nearing failure sounds like a flushing toilet. Every operating part, according to Balderston, has its own unique, high-frequency beat, hiss or tinkle which changes as it wiggles and waggles and wears out.

Balderston has listened to the sounds of life itself. He found that an artificial heart valve in a human patient had an acoustic pattern different from a real heart valve. His work with hydraulic fluid flow indicates there is a distinct possibility equipment may someday be developed to listen to the sound of blood flowing through a patient's body, much the way a doctor now listens to a heartbeat with a stethoscope.

At present, detecting these silent sounds requires expensive, bulky equipment. However, in 10 to 15 years, when microelectronic designs are more fully developed, the failure detector could consist of 5,000 circuit elements interconnected in a structure the size of an ice cube and sold for under $10.

A likely early use of failure detectors would be to tune in on automobile problems. Relatively inexpensive equipment could be developed to attach briefly to a transmission, engine, or other automobile power equipment. The mechanic then could listen for indications of trouble. Auto makers already have shown interest in developing this kind of diagnostic equipment.

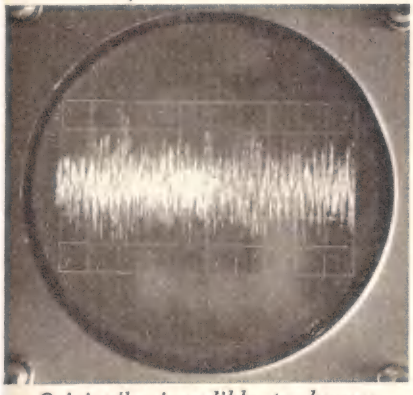
Balderston is currently at the equipment-designing stage of his work, piecing together hardware that could detect the beginning stages of failure in structural, mechanical, hydraulic or electrical/electronic systems during normal operation. Balderston has discovered several important rules for listening to the silent sounds of failure in the course of his research: (1) all failures are either the result of structural defects or chemical contamination; (2) a defect in one part of a system sets everything in that system to vibrating, and (3) the energy level of the frequencies associated with a failing part is 10 thousand to a million or more



Boeing's Harvey Balderston makes a recording of inaudible noise for later examination at reduced speed.

times higher than normal resonant frequencies. For example, the energy level of bubbles from leakage in a hydraulic valve near failure is an astronomical three thousand million times higher than the level in a good valve.

With these and a few other rules of thumb to go by, Balderston expects to perfect equipment that will quickly and automatically isolate trouble in aircraft and other mechanical systems long before there is any other indication of trouble. A programmed card would be inserted in the test equipment to check bearing surfaces, for example. All bearings could be checked at once, and a meter would indicate the relative amount of wear. More important, redline emergency condition could be preset on the card, and if detected noise exceeded a certain level, a light would flash, indicating that one of the bear-



Originally inaudible to human ears, but nevertheless there, the noise generated by a faulty bearing shows up in this oscilloscope trace.

ings should be replaced. As visualised by Balderston, the test equipment could be made small enough to be hand-held and, with a change only of the programmed card, one piece of equipment could be used to check any number of systems, whether mechanical, electrical or structural.

For checking most systems, it will be sound inaudible to man which will be recorded. However, when these sounds of failure are brought into the range of human hearing they provide dramatic evidence of the secrets being discovered. Especially surprising is the noise of crack-resistant metal trying to sew itself into a strong lattice-like structure to stop a crack from spreading. Slowed down to human hearing range, this sound is a series of bell-like tinkles, not unlike falling splinters of glass.

"It is the sound of molecules falling into stronger structural units," Balderston explained.

Perhaps the most spectacular proof of the new failure detection system came about quite by accident. Demonstrating his technique to a group of Boeing officials. Balderston set out to show how a deliberately damaged bearing registered a much higher resonant frequency than a new bearing. However, to Balderstons's surprise, just the reverse happened. The new bearing had a higher frequency reading than the damaged bearing. Disassembly showed the new bearing had a deep gall across its face, a flaw actually more severe than that inflicted on the test bearing.

Such are the secrets whispered by the sounds of silence ■

ICIANZ SYDNEY-MELBOURNE DATA LINK

Data recording, transmission and printing equipment costing $73,000 has been installed by ICIANZ to link its head office computer in Melbourne off-line to its production complex at Botany, N.S.W.

Previously, punched cards and computer reports were flown between the two locations. When surveyed in May, 1969, the volume was 150,000 characters a day going to Melbourne, and 750,000 coming back, and these figures have since grown. It was decided that the mailbag system would not be flexible or fast enough to handle adequately the large volumes of data required for new projects to be implemented later this year.

MDS equipment, marketed in Australia by NCR, is used to transmit the raw data to Melbourne, and after processing by an IBM360/50 the results are retransmitted and printed out at Botany. The system uses 360-compatible formats. The whole system allows the Botany management to have reports on the previous day's operations printed out first thing in the morning, and allows two runs per day for important jobs.

Each day punched cards are collected at Botany and read into a MDS 6409 device, which writes the information on to magnetic tape at a speed of 190 cards a minute. The tape is then placed in a MDS 6403 for sending the data automatically to Melbourne by private line via a P.M.G. modem, at a rate of 100 characters per second.

It is not essential to transfer the tapes to the 6403, as the 6409 is also capable of transmitting; but the 6403 is used to allow time sharing between printing, transmission and card reading.

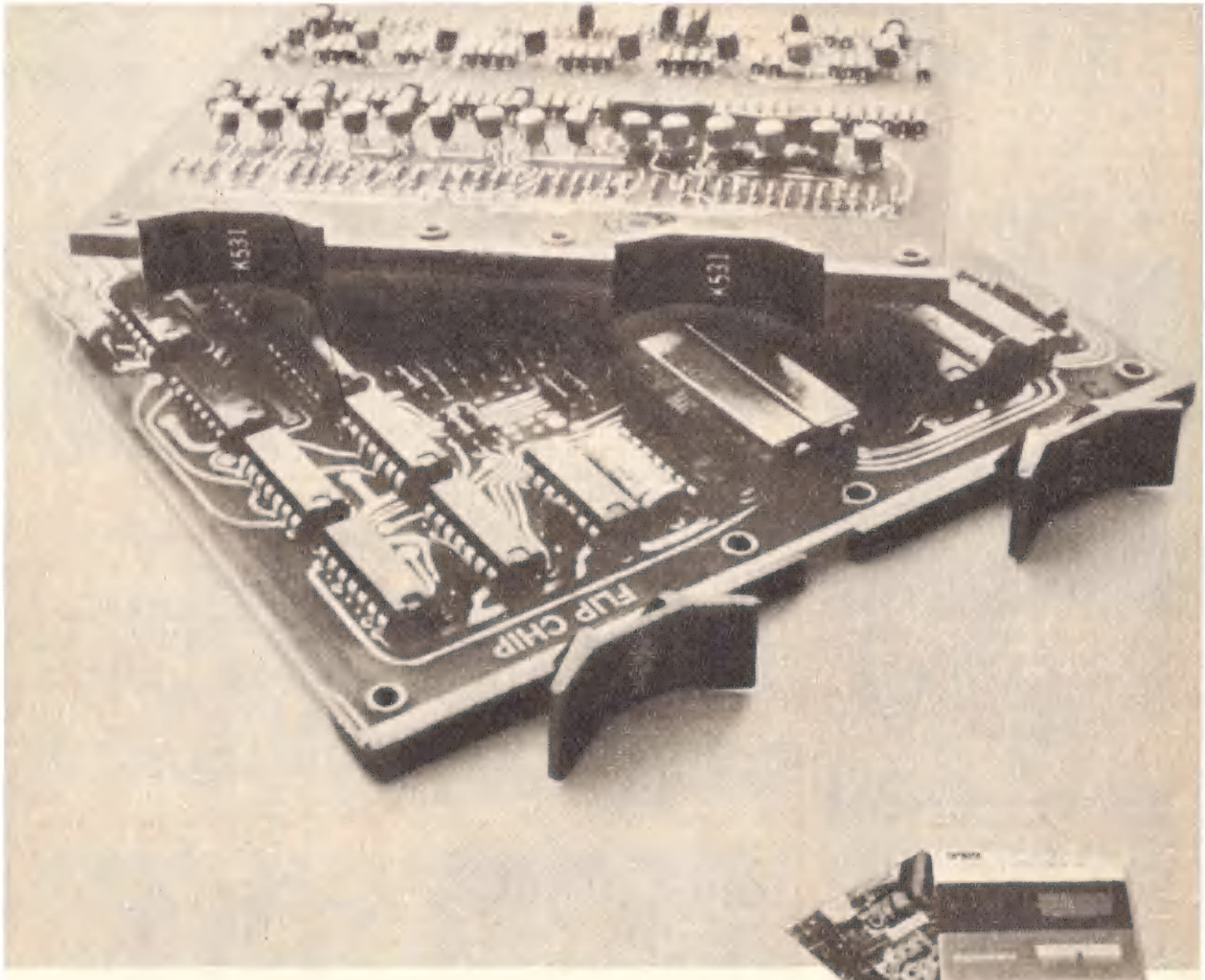
At the other end, the signals are decoded by modem and an MDS 6415 records the data on magnetic tape, which is fed to the computer.

Results from the computer are recorded on tape and retransmitted by the 6415 to Botany. Here the data is written back on to tape on the 6403 and the reels transferred to the 6409.

The 6409 is cable-connected to an MDS 1320 buffered off-line printer, the first such machine to be installed in Australia. This machine has 132 print positions and operates at a nominal rate of 300 lines a minute. It has logic to format print lines from control characters on the tape. An important feature of the system is that line space and vertical slew instructions do not have to be transmitted, thus saving time and effort in transmission.

The 6415 also performs the task of preparing magnetic tape from punched paper tape. Each of the MDS devices is capable of directly encoding data to magnetic tape via the keyboards. This is especially useful for entering input instructions.

The Sydney end of the data link. Peter Adams (centre), management services systems officer of ICIANZ's Botany site co-ordinating section, discusses with colleague Bob Gibson output data sent by private line from the head office computer in Melbourne. Data recorder Ann Defries sits at the keyboard of the MDS 6409 to prepare magnetic tapes.



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SSB FOR FLYING DOCTOR SERVICE

One of the R.F.D.S.'s modern Beechcraft aircraft.

As a result of international agreements, under which there will be a general conversion of HF communications equipment to single-sideband operation, the Royal Flying Doctor Service will be required to change over to single-sideband operation in about five years.

The Royal Flying Doctor Service operates one of the largest fleets of light aircraft in Australia, with some 20 aircraft operating on the mainland. (In Tasmania, the service uses chartered aircraft.) Three aircraft operate from Mt. Isa and Charters Towers; three from Broken Hill; four from Port Augusta and Alice Springs; two from Kalgoorlie; seven from other bases in Western Australia; and one from Wyndham and Broome. This medical service could not operate effectively without the widespread radio network which links outback stations to the 12 bases listed above. Now, what has become the largest high frequency radio communications network in the world is to be re-equipped at a cost of about $3.75 million.

The radio communications system which enables the medical service to operate over the wide reaches of Australia, beyond the limits of the normal telephone and telegraph services, has thousands of transmitter-receivers operating into the 12 base stations. The R.F.D.S. does not know exactly how many individual stations are operating, but estimates the number at about 5,000. Some of these are fixed stations, others are mobile, but they hook into a network which covers two-thirds of the continent.

The present network allowed the R.F.D.S. doctors to give 20,000 medical consultations by radio in the 12 months to 30/6/69. The service's aircraft, with the assistance of radio, enabled the doctors to attend 55,000 patients in the outback, and transported 4,000 patients to hospital in the same period. Numerous people were informed by radio about dentists' visits, and R.F.D.S. aircraft transported the dentists to centres where they conducted clinics at which 3,791 patients were treated.

In addition to its primary purpose of seeking medical advice or summoning medical assistance in serious cases, the radio network serves a useful subsidiary purpose as a means of normal communication between homesteads; also in the financial year to the end of June, 1969, the service handled 327,416 radiograms. The network also makes possible the School of the Air teaching service for the children of outback dwellers.

The R.F.D.S. is collaborating with the Postmaster-General's Department in planning the changeover to single-sideband. Also, advice is being given by members of the Australian Telecommunications Development Association (A.T.D.A.).

A.T.D.A. member companies have put a lot of effort into developing lighter, more compact and more reliable equipment for the R.F.D.S., so that when the conversion is completed the inland radio communications system will operate with the greatest possible efficiency and effectiveness. The small but powerful transmitters and sensitive receivers which will be used under the new system, operating for long periods from small batteries, are a far cry from the cumbersome pedal-generator sets with which the service began.

Although the target date for the changeover is 1975, it is now expected to be 1976 before the task is completed, because of the sheer size of the operation. Tenders have already been called for the supply of the base station transmitter receiver equipment. This part of the conversion is expected to cost in the region of $480,000. The cost of re-equipping the base stations is to be borne by the Commonwealth Government. However, individual users of the service will have to bear the cost of replacing their transceivers.

These transceivers are scattered far and wide, in station homesteads, in outstations, and in the trucks of drovers, geologists, prospectors, surveyors, hauliers and others. The new transceivers are expected to cost between $500 and $600 each, and the total cost of the conversion program is expected to reach about $3.75 million. To ease the burden of replacing transceivers, it has been suggested that leasing arrangements could be provided. ■

One of the Flying Doctor Service aircraft operating shortly after World War 1.

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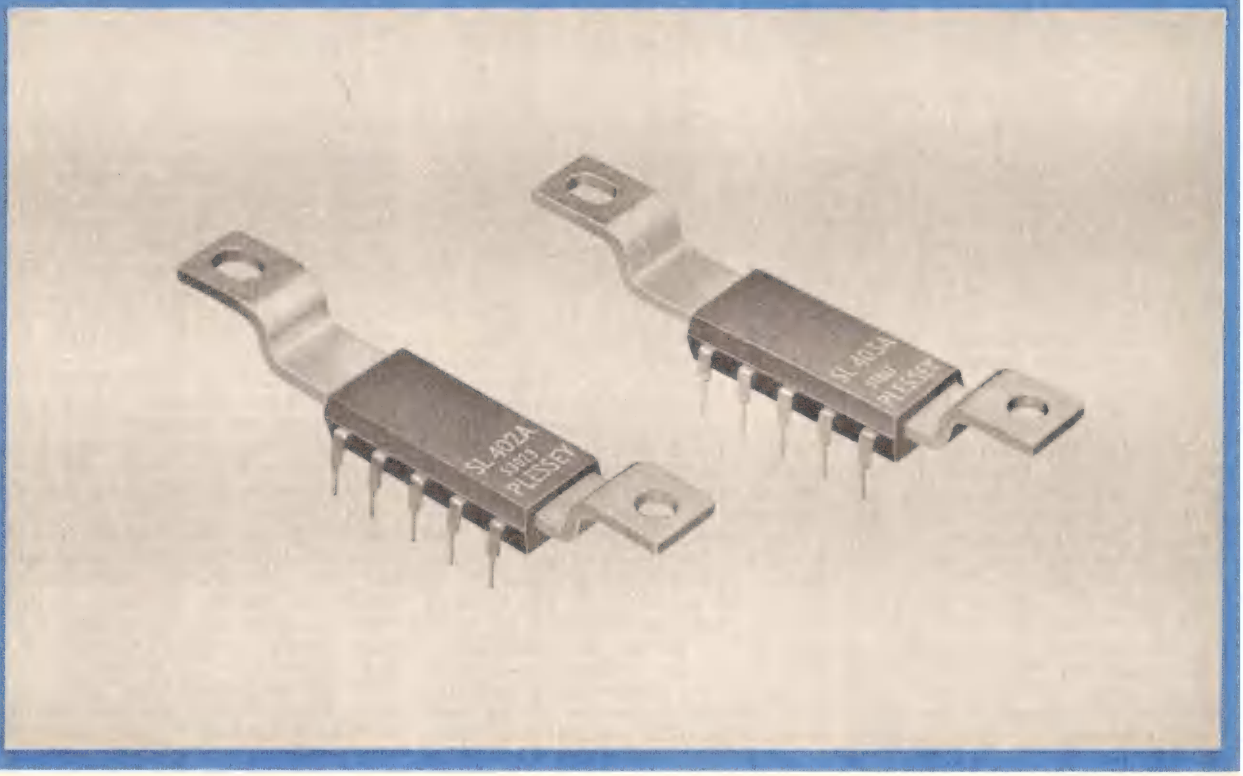

Performance Characteristics		SL402A	SL403A
Output power r.m.s.		2 Watt	3 Watt
Input impedance	Preamplifier	20 MΩ	20 MΩ
	Main amplifier	100 MΩ	100 MΩ
Distortion	Preamplifier	0.1%	0.1%
	Main amplifier	0.3%	0.3%
Frequency response	Lower 3db point	20 Hz	20 Hz
	Upper 3db point	30 KHz	30 KHz
Operating voltage		+14 V	+18 V
Minimum operating load		7.5 Ω	7.5 Ω

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AD14

TECHNICAL DIGEST

Camera with electronic automatic focusing

A newsreel camera fitted with an electronic automatic focusing device has been demonstrated in the U.S.A. The Automatic Infrared Rangefinder (AIR), made in Switzerland by the Bolex company, uses a modulated beam of infrared light.

The Bolex-made system, previewed at several photographic shows, will cost about $US700 when it reaches the market. The AIR demonstrated recently was fitted to the Bolex 16 Pro, a newsreel camera with built-in power focusing. The 4 x 4 x 8-inch electronic and optical package guarantees accurate focusing between 5 and 80 feet. A 12-volt battery powers both the camera and AIR.

To hit the camera subject with a narrow beam of modulated infrared light and receive the reflected radiation, the optical system shown in the diagram is used. A Schott glass infrared filter (2) absorbs most of the visible light from the projector lamp (1), which is positioned at the focal point of a Mangin mirror (3). (This is a concave lens with a reflective coating on its rear surface.) The mirror curvature is designed so the infrared spot on a target 30 feet away is only 3 inches in diameter.

Part of the infrared light reflected from the subject strikes the larger receiving Mangin mirror (8). This light may be an extremely faint 10^{-14} watt, and of course is mixed with other light wavelengths — unwanted for AIR operation, but necessary to expose ordinary film. The larger Mangin mirror focuses light from the camera subject into a ring-shaped image that shifts along the mirror axis slightly as the subject moves away from or toward the AIR.

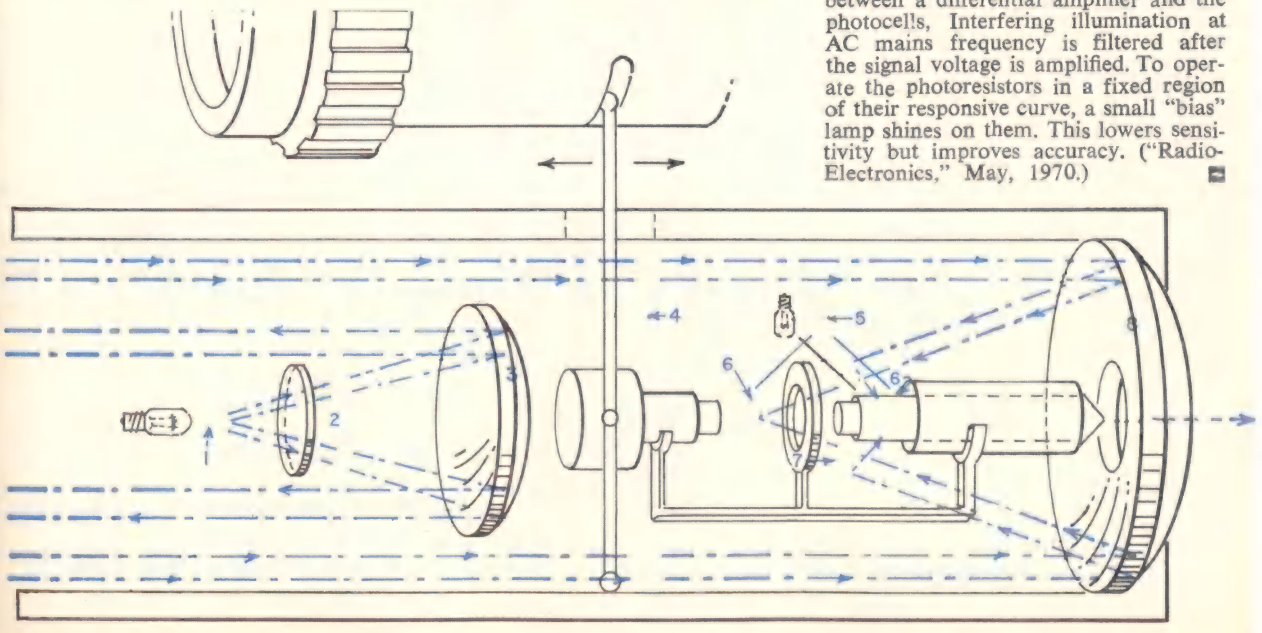
This image is directed toward a ring-shaped separator mirror (7) positioned between two infrared-sensitive photocells (6). The separator mirror/photocell assembly can move along the receiving mirror's axis, tracking the moving image.

When a camera-shy public figure hurries away from the AIR his image moves down the mirror axis, passing through the hole in the separator mirror and falling only on the left photoresistor. This unbalances the photoresistor/servo circuit (described later), which sends a signal to a servomotor telling it to move the mirror/photocell assembly down the mirror axis and "hunt" for the image missing on the right photoresistor. Simultaneously, the motor moves the camera lens into focus (4).

When the separator mirror moves into the correct plane with the image, some light passes through the separator mirror to the left photoresistor and some is reflected to the right photoresistor. With both photocells illuminated, the servo motor does not receive a drive signal. If the cameraman moves closer to the subject, or vice versa, only the right photoresistor will be illuminated, and the mirror/photocell assembly will move toward the receiving mirror until equilibrium is achieved again.

Everything a cameraman points the AIR at emits infrared light, so the advantage of modulating the infrared projector is obvious: it makes the AIR's light beam stand out from the infrared "chaff." Bolex selected 25Hz as the central multivibrator frequency since at higher frequencies the lamp filament would not dim enough between pulses to provide a well-modulated beam.

Voltages generated in the photoresistor circuits by continuous light (sunlight, car headlights, and so on) are filtered out by capacitive coupling between a differential amplifier and the photocells. Interfering illumination at AC mains frequency is filtered after the signal voltage is amplified. To operate the photoresistors in a fixed region of their responsive curve, a small "bias" lamp shines on them. This lowers sensitivity but improves accuracy. ("Radio-Electronics," May, 1970.)



Study events never "seen" before

NEW RCA-C70133B QUANTACON PHOTOMULTIPLIER

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Here's an exciting new light sensitive device from RCA—the C70133B, an RCA QUANTACON photomultiplier—that can open up for study events never "seen" before.

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DIGEST

"SOUND PEN" MAY SUBSTITUTE FOR LIGHT PEN

A "sound pen" and associated display system developed in the U.S.A. by Science Accessories Corp. may be used in some instances as a substitute for the more expensive light pen used as an input device for computer graphic displays.

The company has developed such a graphic input device for use with a digital computer. Called the Graf/Pen, the unit has no active elements. It senses the position of a hand-held pen by timing the propagation of sound between a source at the tip of the pen and sensors placed around the edges of the tablet or screen.

Including a tablet, stylus, and controller, the Graf/Pen also can be used with a cathode-ray tube display or an x-y recorder. The stylus combines a ballpoint pen and a tiny spark gap — the spark generates a sound pulse with an extremely fast rise time. Two capacitive microphones are located along the x and y axes of the tablet; they detect rise times from the sound wave of about 0.2 microsecond and at the same time filter out ambient noise.

When the controller initiates a spark, two 10-bit counters — for the x and y directions — and a clock are triggered. The counters start at 0 and increment continuously while the sound wave travels through the air. When the microphones detect the wave's leading edge, the counters stop; the binary numbers they contain are proportional to the x and y distances of the pen's tip from the tablet's edge. The controller determines the pen's position from the counters' contents. When the counters stop, the controller generates an output-ready pulse that can be used as a program interrupt or punch command for transferrring the binary value of the counters to a digital computer, or for storage on a program tape.

Co-ordinate pairs are generated — up to 200 per second — with each spark. When the stylus is moved, the counters reset and start counting anew, corresponding to the new position of the stylus on the tablet. The pen can be operated in either free-run or one-shot modes. In the free-run mode, the repetition rate of the sparks can be continuously varied from 1 to 200 per second. In the one-shot mode, one co-ordinating pair is transferred on command from the computer or at the instant that the stylus tip contacts the tablet or CRT face.

Tablet size can be as large as 14 x 14 inches, which the 10-bit binary counters divide into 1,000 parts each way, for a resolution of 0.014in. But the tablet can be expanded to 33 inches square, says Science Accessories, at little added expense or limitation in resolution.

The Graf/Pen sells for $US2,800 in single quantities. The components are readily available and inexpensive. The microphones are made of aluminium extrusions and aluminised Mylar foil. The pen contains ordinary, inexpensive ballpoint refills, and all the electronics are digital integrated circuits. "Our complete unit cost," says the company, "will be cheaper than that of some light pens."

The advantage of this system over other units such as the Rand Tablet is its flexibility, it is claimed. The Rand Tablet contains crossed-wire grids and uses capacitive sensing — an inherently expensive process that limits the size and format of the tablet. Increasing the size of the Graf/Pen tablet requires only longer microphones along the tablet's edges.

In addition, microphones can be mounted very easily on the bezel or mounting frame of cathode-ray tubes for interacting with the CRT. Since the pen does not depend on light for sensing patterns on the scope, the stylus can interact with both light and dark areas on a scope, and with high resolution.

One of the more interesting applications for the Graf/Pen is in tracing out, either pointwise or continuously, photographic images projected from the rear on to the tablet using a frosted lucite plate. Areas of land contours, weather patterns. and X-rays can be outlined and transferred to a computer as digital data. ("Electronics," 22/12/69.) ■

New hologram technique announced

Processing techniques to produce highly efficient holograms (in which more than 30 per cent of the light goes into the image) with high contrast ratios were described recently at a meeting of the Optical Society of America.

Standard silver-halide emulsions and processing chemicals are used to produce holograms that have efficiencies comparable to those previously obtained only with such media as dichromated gelatins. Their contrast or signal-to-noise ratio, a measure of the quality of the image, is better than 50 to 1. Silver-halide emulsion also has the advantage of a hundred-fold greater sensitivity than dichromated gelatins. High efficiency and signal-to-noise ratio are important to such potential applications of holography as read-only memory, microcircuit mask projection, optical processing and displays.

As described by John S. Harper and Keith S. Pennington of the International Business Machines Corporation's Research Division, the high-quality holograms result from a collection of processing steps designed to minimise emulsion distortions during the development process. In normal photographic processing, expansion and contraction of the emulsion produces significant surface irregularities and displacement of the silver particles by as much as 5 to 10 microns. Such distortions introduce large amounts of noise in the reconstructed images.

The processes developed by Dr Pennington and Mr Harper apply to "bleached" holograms plates in which the silver particles are converted to transparent compounds which have a different index of refraction from that of the gelatin matrix. Bleached holograms are more efficient than "amplitude holograms" in which the silver particles are opaque (as in conventional photographic negatives) and thus block much of the incident light. Bleached or "phase" holograms produce images by altering the phase relationships among the light waves passing through them.

Photomicrographs showing improvement in surface smoothness of holograms processed by the new technique (left) and the old technique.

Among the techniques described in the Harper-Pennington paper are:

Stress relief of the film by exposure to a humid atmosphere.

Pre-hardening of the emulsion using conventional hardening agents.

Development with minimisation of "tanning" (cross-linking of the emulsion molecules).

Alcohol baths of increasing concentration to minimise drying stresses. ■

DIGEST

RADIO-SOUNDING EQUIPMENT MEASURES ARCTIC ICE CAP

A radio sounding technique which evolved almost by accident is being used in Denmark to measure the thickness of the northern ice cap.

Echo soundings made with the aid of ultrasonic soundwaves have already been used for a long time at sea for measuring depths and for charting submarine "landscapes." Echo soundings made with radio waves had been put to a wide range of uses before the researchers hit on the idea, almost accidentally, that it might be possible to adapt the method for measuring ice thicknesses and for mapping out "landscapes" under the ice in, for instance, Greenland or Antarctica.

In experiments conducted during the International Geophysical Year (1957-58) it appeared that in many cases incorrect results were obtained if radio waves were transmitted from ionosphere stations on the thick ice shelf to the ionosphere "radio mirror." Such errors can only be explained by the fact that some of the radio waves do not travel directly from the transmitter to the ionosphere, but are deflected downwards to the sea water below the iceshelf and only then back into the air.

The principle on which radio-echo soundings are made is that the time is measured which it takes a radio pulse to travel vertically downwards to the ice and back after having been reflected by the boundary surface between the ice and the rock below it.

Since the speed of propagation of radio waves in ice is known, the thickness of the ice can be determined — if it is possible to record the reflected radio waves. The radio signals transmitted are attenuated to some extent during the passage through the ice (an attenuation which, for that matter, varies as a function of the temperature of the ice) and provisions for this are made in the calcualtions.

American and British parties both started to develop a radio-echo sounding installation that could be fitted on a motor sledge, by means of which continuous measurements could be made of the ice, while the sledge was driving on the icecap. Both instruments were used in Greenland in 1964. Here a strip of land of 220KM between the American stations "Tuto" and "Century" was mapped out. A stretch of 65KM from "Century" towards the south and another 80KM north-west were also included.

When travelling from "Tuto" to "Century" one first moves over an ice-covered mountainous area, after which one arrives at a plateau, 600M above sea-level. Yet, the actual height is 1900 metres. because the plateau is covered by a layer of ice with a thickness of 1300 metres.

The leader of the British group, Dr. S. Evans, said in 1965 that the British would try to develop a radio-sounding installation that could be used from aircraft.

In co-operation with the international circle of polar scientists working in Greenland and Antarctica, Mr Preben Gudmandsen, lecturer, and Mr Erik Lintz Christensen, electronics engineer, recently visited Greenland and flew over the ice on the mainland and a few West-Greenland glaciers with echo-sounding equipment.

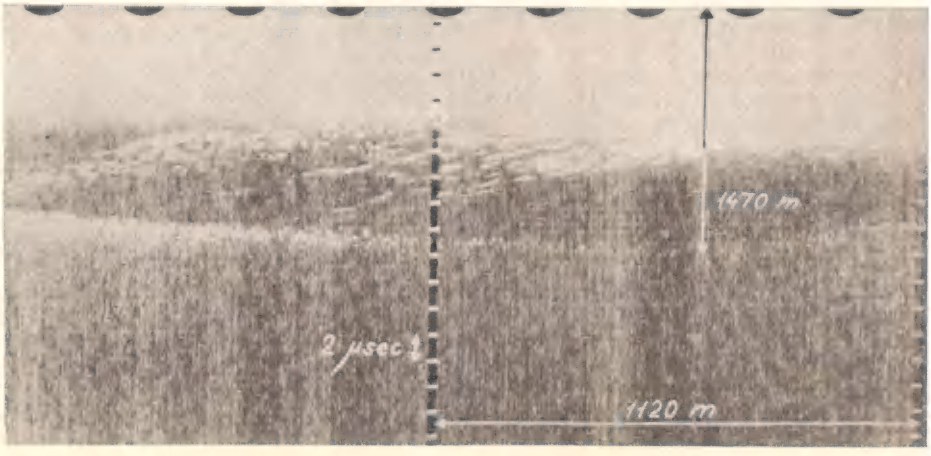
For this "range finding trip," they used a chartered DC4 plane. which is the type commonly used for ice reconnaissance. This aircraft made seven flights with a total duration of 18½ hours.

The plane accommodated the transmitting equipment which French glaciologists had used for making measurements from a sledge in Greenland. It is a copy of the transmitting equipment developed by the British for use on sledges, its frequency being 35-MHz. Receiving equipment and aerials were also carried.

The mounting of the aerials caused some difficulties. The scientists wanted the aerials to be fitted at a distance of 2.4 metres away the wings, but were told that for safety reasons a distance of one metre could not be exceeded. It was not only the unfavourable position of the aerials that caused difficulties during reception. The aircraft could not fly at the altitudes the scientists required, because at those heights the interference was much greater than expected. What had not been anticipated was the great deal of interference from European and American short-wave broadcast stations. Because of the high sun-spot activity, these radio waves were very strong in Greenland. They mixed with the radio sounding signals and obscured the reflected signals received when the transmitter was flown over the ice at an altitude of 600 metres. Satisfactory results were not obtained until the aircraft was brought right down to 30 metres altitude, and then only for measurements down to a depth of 2200 metres.

It is considered too dangerous to fly routine ice sounding flights at such low altitudes. While equipment mounted on land travelling vehicles could prove useful in some instances (i.e., measuring inland ice) the method is slow compared with airborne surveys. Moreover, land vehicles cannot be used to measure ice thickness of glaciers because of the numerous crevasses.

Work is proceeding on the development of new equipment to operate at the higher frequency of 60MHz which will not be affected so much by signals from short-wave stations. Receivers with improved sensitivity and selectivity are also being developed, as well as aerial systems with greater directivity. Experimen s are also being conducted to devise equipment which would allow accurate measurement of the ice crust over the sea, information which will greatly assist ships which intend to travel in the Arctic waters. (Condensed from an article in "Philips Electronic Measuring and Microwave Notes.") ■



A "radio-echogram" of glacier ice. The white area at the top is caused by reflections from the rough ice surface. The lower, nearly uninterrupted line represents the rock below the ice. The oblique lines are caused by crevasses in the glacier. The 2 microsecond calibration marks each represent an ice thickness of 169 metres, and the greatest thickness of ice is indicated by the arrows at the right.

Mullard Special Quality Valves

for Industrial Applications

This chart enables you to identify at a glance the Mullard Special Quality Valve equivalents of C.V. Services Types, American Types and Mullard Standard Types. In addition abridged data is provided to assist in the selection of the Special Quality Valve most suited to your specific circuit requirements. Further information is available on request.

SPECIAL QUALITY PRODUCTION			DESCRIPTION	STANDARD PRODUCTION		
Mullard Type Number	Services Type Number	American Type Number		Mullard Type Number	Services Type Number	American Type Number
E55L	CV5808	8233	High slope wideband output pentode	—	—	—
E80CC	CV5989	6085	Double triode for industrial use	—	—	—
E80CF	—	7643	Triode pentode with separate cathodes	ECF80	CV5215	6BL8
E80F	CV2729	6084	Voltage amplifying pentode	—	—	—
E80L	—	6227	Output pentode	—	—	—
E81L	—	6686	Output pentode	—	—	—
E83F	—	6689	Voltage amplifying pentode	—	—	—
E86C	—	—	U.H.F. triode	EC86	—	6CM4
E88C	—	—	U.H.F. grounded grid triode	EC88	—	6DL4
E88CC	CV2492	6922	Double triode for use in computers and cascode circuits	ECC88	CV5358	6DJ8
E88CC/01	CV2493	—	Double triode for use in computers and cascode circuits	—	—	—
E90CC	CV5214	5920	Double triode for use in computers	—	—	—
E91H	—	6687	Dual control heptode for use as a gating valve	—	—	—
E92CC	—	—	Double triode for use in computers	—	—	—
E180CC	CV8431	7062	Double triode for use in computers	—	—	—
E180F	CV3998	6688	High slope wideband amplifying R.F. pentode	—	—	—
E182CC	CV5766	7119	Double triode for use in computers	—	—	—
E186F	—	7737	High slope wideband amplifying R.F. pentode	—	—	—
E188CC	CV5354	7308	Double triode for use as cascode amplifier	—	—	—
E280F	—	7722	High slope wideband amplifying R.F. pentode	—	—	—
E288CC	—	—	Double triode	—	—	—
E810F	CV5809	7788	High slope wideband amplifying pentode	—	—	—
EC1000	—	8254	Subminiature triode for use in measurement probes	—	—	—
ECC2000	—	—	Double triode for use as V.H.F. cascode amplifier	—	—	—
M8079	CV4025	‡6058	Double diode with separate cathodes	EB91	CV140	—
M8080	CV4058	‡6100/6C4WA	R.F. power triode	EC90	CV133	6C4
M8081	CV4031	‡6101/6J6WA	V.H.F. double triode with common cathode	ECC91	CV858	6J6
M8082	CV4063	‡6516	Output pentode	EL91	CV136	—
M8083	CV4014	‡6064	R.F. pentode with separate g3	EF91	CV138	—
M8091	CV4044	‡6443	Half-wave rectifier designed for operation at high altitudes	EY84	CV2235	—
M8096	CV4039	‡6062	V.H.F. power tetrode	QV03-12	CV2129	5763
M8097	CV4059	—	Low impedance diode with medium μ triode	EAC91	CV137	—
M8099	CV4070	—	Triode for use as grounded grid amplifier	EC91	CV417	—
M8100	CV4010	‡5654/6AK5W/6096	Low noise, R.F. pentode	EF95	CV850	6AK5
M8136	CV4003	‡6189/12AU7WA	Low μ double triode	ECC82	CV491	12AU7
M8137	CV4004	‡6057	High μ double triode	ECC83	CV492	12AX7
M8161	CV4015	‡6065	Variable μ R.F. pentode	EF92	CV131	—
M8162	CV4024	‡12AT7WA	Medium μ double triode	ECC81	CV455	12AT7
M8195	CV4085	—	Low microphony, low hum A.F. voltage amplifying pentode	EF86	CV2901	—
M8196	CV4011	‡5725/6AS6W	Dual control pentode	6AS6	CV2522	6AS6
M8212	CV4007	‡5726/6AL5W/6097	Double diode with separate cathodes	6AL5	CV283	6AL5
M8248	CV5311	‡6J4WA	U.H.F. grounded grid triode	EC98	—	‡6J4

‡The American types shown in this chart have the same electrical characteristics as the appropriate Mullard Special Quality type and they may, in general, be regarded as interchangeable. In the case of those types marked ‡ there are, however, certain differences in the test specifications.

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SCIENTIFIC AND INDUSTRIAL NEWS

TV for Fiji and Tonga

Late last year, the Government of Fiji appointed a committee to inquire into and report on the development of radio and TV in the Fijian Islands. Electronic Industries Ltd. has submitted a proposal to the committee that may not entail the expenditure of public moneys. Under the proposal, the company would underwrite the capital required by Fiji Television Ltd., a company registered in 1964 for this purpose. E.I.L. would retain a holding of about one third of the shares and the balance would be offered for subscription by local residents. The equipment specified for Fiji would be colour compatible to reduce the cost of preparing for colour programs at a later date.

A proposal for a three-stage introduction of TV to the Tongan Group was discussed by representatives of Electronic Industries with the King and Government of Tonga. It entails the building of small stations (to be served with video-taped programs) at three strategically situated points in the islands to provide coverage for about 80 per cent of the Tongan people. E.I.L. would form a company to build and operate the stations, and would offer a substantial percentage of the capital for subscription by residents of Tonga. It was suggested that where people could not afford their own set, receivers could be placed in meeting places for community viewing.

Oxygen regeneration

Westinghouse research engineers in the U.S.A. have designed a system to reclaim oxygen from the breath of astronauts. NASA is financing the development of a reliable, light-weight oxygen regeneration system based on the Westinghouse solid electrolyte battery. The battery and a carbon deposition reactor have completed more than 100 days continuous testing. The battery, basically a fuel cell unit, operates in reverse for the new system.

The battery is constructed of a number of thin-walled cylindrical electrolysis cells consisting mostly of zirconium oxide, which has the property of permitting negatively charged oxygen ions to migrate easily through it. Carbon dioxide and water vapour from the air in the spacecraft is passed into the cell where electricity is used to break them down into carbon monoxide, hydrogen and oxygen ions on one side of the cylinders. The oxygen ions are pumped to the other side where they combine to form pure oxygen atoms. The hydrogen is passed into space through a membrane of palladium. The carbon deposition reactor uses iron heated to 1,400 deg F as a catalyst to change the carbon monoxide into carbon dioxide, which is re-cycled, and solid carbon which can be stowed in empty food storage space. (Westinghouse News & Information Service, G.P.O. Box 3270, Sydney 2001.)

Computer for new university

The James Cook University of North Queensland, which became autonomous on April 20, has placed an order for a large scale PDP-10 time sharing computer to be installed in October this year. The computer, to be supplied by Digital Equipment Australia Pty. Ltd., will simultaneously provide multi-language terminal facilities with multi-programmed batch operation and, if required, on-line control of laboratory experiments. Research, administrative and teaching applications will constitute the bulk of the computing workload, but a service will also be provided for outside users.

CCIR assembly

The XIIth Plenary Assembly of the International Radio Consultative Committee (CCIR), one of the four permanent organs of the International Telecommunication Union, met in New Delhi, India, between January 21 and February 11, 1970. The Assembly was attended by over 300 delegates representing 59 Governments, 23 companies operating telecommunication systems, and 5 international organisations. The main object was the discussion and approval of nearly 600 texts concerning radio-technical subjects proposed by the 15 Study Groups of the CCIR.

Some of the more noteworthy texts concerned such subjects as: the use of satellites for the transmission of telephony and television; the use of computers to improve the reliability of forecasts of usable frequencies; the general question of the reliability of radio services; the study of the technical and economic factors related to the broadcasting of both sound and vision programs from satellites; the means of facilitating participation in the work of the CCIR to new or developing countries.

Aircraft noise research

A Lockheed Q-Star aircraft, developed to research the techniques of quiet flight. A wide-winged, extremely quiet aircraft, it has its engine mounted behind the pilot. A 10ft shaft passes from the engine over the cockpit to a pylon rising from the nose to support a slow-turning, multi-bladed wooden propeller. Despite the engine hump, relatively little power is needed to keep the airplane aloft; low power being an important factor in low noise emissions. Tests included the use of different propellers, said to be a major source of airplane noise. Three, four and six-bladed propellers have been used with two different engines in the tests.

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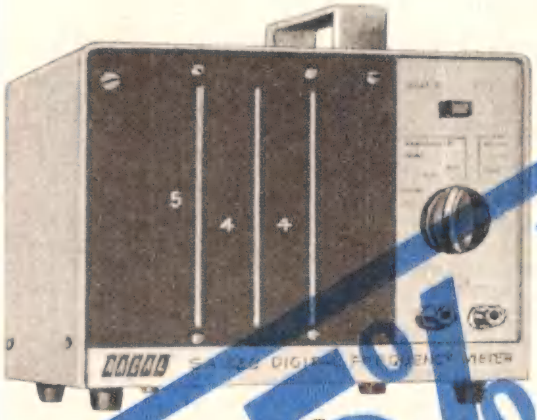

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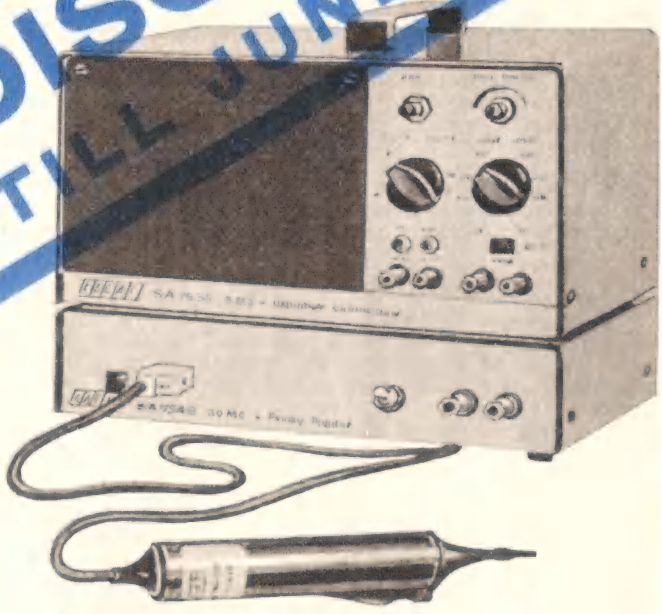

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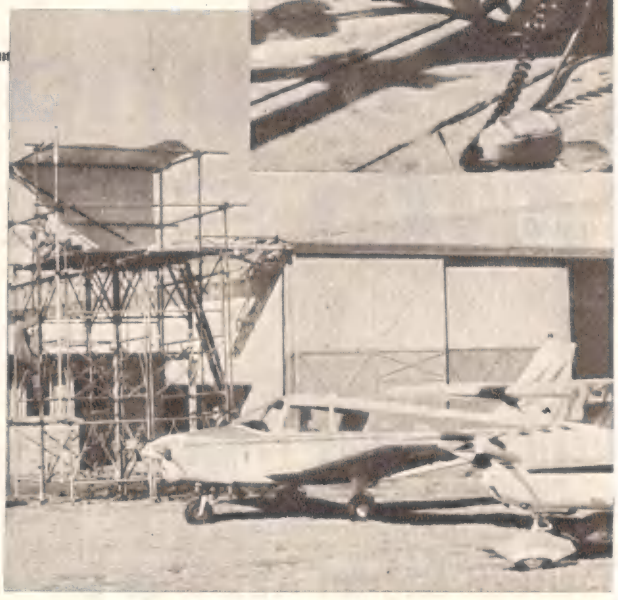
Toowoomba air pageant

An air pageant, organised by the Jaycees, was held at the Wilsonton Aerodrome, Toowoomba, Qld., on April 19. The Department of Civil Aviation declared a temporary control zone for a radius of five miles up to 9,000ft. A temporary control tower was erected and manned by two air traffic control officers. Control was on 118.7MHz using two Vinten transceivers in the control tower. One was mains operated, the other was a 12V transistorised version for emergency operation. About 40 aircraft took part in the display which included a number of aerobatic demonstrations.



RIGHT: The transceivers used at the air pageant. BELOW: The control tower erected for the occasion.

Time-division communications

The Overseas Telecommunications Commission's earth station at Moree is to take part in field trials this month of a system, known as MAT-1, which could increase the message-carrying capacity of future earth satellites by six or seven times. Developed by Comsat, the American corporation which operates the Intelsat satellite system, the MAT technique is a time division system. The total available bandwidth, equivalent to 600 two-way voice channels, is divided into segments of 125uS each. The message (whether telephone or telegraph, but not television) is coded using PCM methods into digital binary form transmitted in bursts 8,000 times per second.

Messages from each ground station working through the satellite are sent in bursts, with the appropriate routing directions, interspersed with similar messages from other stations in the total bandwidth, and reconstructed at the receiving end. The field trials will involve simultaneous telephone conversions between Moree, Ibaraki in Japan, and Paumalu in Hawaii.

Small aerial dishes

GEC-AEI (Electronics) has been awarded a contract by the British Ministry of Defence to develop a small shipborne satellite communication terminal (SCOT) to operate through the Skynet system and provide secure communications links between small warships and the U.K. Two stabilised and fully steerable 3½ft diameter dish aerials are mounted one on each side of a ship's mast. No active equipment is mounted on the aerials, but is located in an engineering cabin at deck level and connected to the dishes by low-loss waveguide. The aerials, each protected by a double skinned radome, are stabilised by a modified version of the inertial unit used in the Black Arrow rocket. All essential operational controls are on a control console in the ship's main communications office.

NELCON '70

Over 50 papers have been offered for Nelcon '70, the New Zealand National Electronics Convention, to be held in Auckland on August 25-28. The papers cover the fields of research, applications, communications, computer systems, components, and instruments. There are papers on such topics as: digital control of artificial kidney systems; blood pressure recorders; lightning counter design; opossum tracking by radio; Otago's radiotelescope; marine SSB radios; emergency radio communication in the Ministry of Works; computer systems. Further information may be obtained from the Secretariat, Nelcon '70, P.O. Box 3266, Auckland 1, New Zealand.

Navigation aid closes

The last three chains of a navigation aid, which had been operating in the U.K. since the early days of World War II, closed down on March 26, 1970. Known as GEE, it was the first "pulse hyperbolic" system to go into operation. A master station and either two or three slave stations transmitted synchronised pulses. The difference in time of arrival of the pulses at an aircraft were then used to fix its position by reference to the families of hyperbolae produced by the two or three transmitter pairs. The original system was superseded by two later models; the GEE Mk. II which was resistant to jamming, and the GEE-H which yielded an accurancy of about a quarter mile.

GEE was based on a proposed approach aid using pulse techniques put forward by Robert J. Dippy in 1938, about two years after he became a founder-member of the British radar team at Bawdsey. In 1942, when GEE was well advanced, he was sent to the U.S.A. to assist in the development of Loran. In recognition of his work he received the O.B.E. and the American Medal of Freedom with Bronze Palm. After the war, he migrated to New Zealand, and in 1957 moved to Australia to join the Weapons Research Establishment, where he is now superintending scientist in charge of the Applied Physics Division. In 1966, the I.E.E.E. gave him the Pioneer Award for "his pioneering contribution to the conception and to the realisation of the earliest hyperbolic radio navigation system put into operation."

Tracking agreement

The agreement under which all United States NASA tracking activities in Australia are conducted has been extended for ten years until 1980. NASA tracking, data acquisition and communication facilities near Canberra, Woomera, Carnarvon and Cooby Creek will continue to be managed for NASA by the Australian Department of Supply. A new 210ft diameter antenna for deep space tracking will be established at Tidbinbilla in the Canberra area. The facilities in Australia represent an investment of over $77 million, employ more than 700 Australian engineers, technicians and support staff, and are operated at an annual cost of about $14 million.

Yugoslavia joins Intelsat

Yugoslavia has become the seventy-fourth member of the International Telecommunications Satellite Consortium (Intelsat.) The Yugoslav ambassador to the U.S.A. and the director general of the Yugoslav Posts, Telegraphs and Telephones deposited the Belgrade Government's instrument of accession to the Intelsat agreement at the U.S. State Department recently.

Thin wire memory

A memory device called the Dyanbit, developed by Hughes Aircraft Co. of the U.S.A., is formed by winding a magnetic wire, thinner than a human hair, helically round a cylindrical substrate. The information is placed on the wire as a pattern of magnetic domains capable of being stored indefinitely or of being moved elec-

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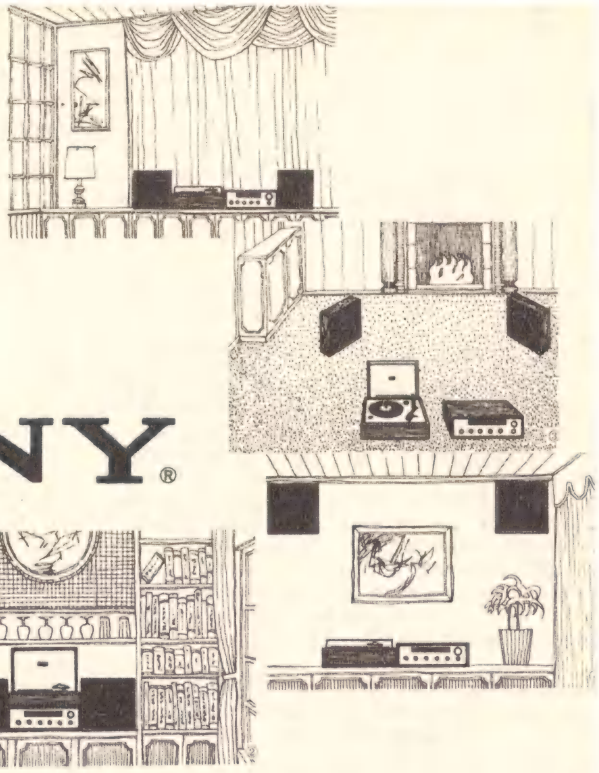

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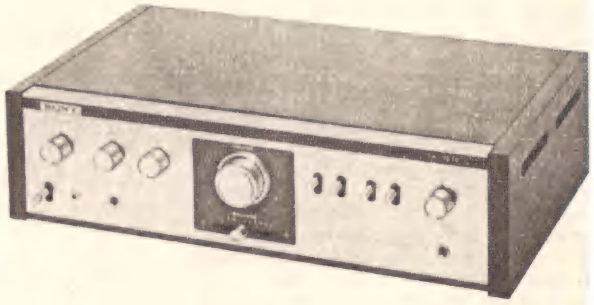

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.....JMS/12-70EA670

tronically at speeds of up to 200K bits per second. The memory element is claimed to be competitive both in price and performances with other memory devices such as drum, disc and tape stores.

Advantages claimed for the system include: reliable, impervious to shock, higher through-put, reduced requirements for buffering locations, no moving parts. In addition, the unit is small — less than 1in in diameter and about 8in long — but with large capacity — it can store more than 6,000 bits.

Teleprocessing capability

Communications capabilities announced by IBM Australia Ltd. for System/3 enable this low-cost computer to communicate with other IBM computers over telephone lines. By means of a new adapter, System/3 can exchange data directly with remotely located System/3s and most models of the larger System/360, and indirectly with IBM 1130 and 1800 computers through a central System/360. With the new capabilities, System/3 can be used as a teleprocessing station in the Australia-wide data processing network announced last month.

Flexible solar array

Under a $79,000 contract from the European Space Research Organisation, the British Aircraft Corporation's electronic and space systems group has designed a new type of flexible solar array to provide a source of sun-powered energy for satellites. The developmental model comprises a blanket, 150cm x 50cm, of film substrate on which has been mounted titanium-silver contact silicon solar cells interconnected by a welding process. The array is stowed on a 20cm diameter drum with interleaved cushioning and can, on command, unroll at a rate of 4cm/sec. It is claimed to have low storage volume and mass compared with the equivalent power output of body and paddle mounted arrays currently in use.

West German satellite

All information radioed from the Azur 1 satellite is passed to the control centre in Oberpfaffenhofen, Upper Bavaria, where it is decoded by a Siemens type 305 process computer. After decoding, the computer displays the data on video terminals, prints them out in plain language, traces out analog data as curves, and records the data for storing for further processing.

A large map of the world is mounted on the front wall of the main control room. A projection device with a gas laser as its light source constantly projects the orbit of the satellite on to this map. The position of the satellite at any time is marked by a light point on the orbital path. The individual ground stations are indicated on the map by small lamps which light up automatically while the associated station is in radio contact with the spacecraft. (See "Electronics Australia," May, 1970, page 35.)

Heat resistant TV tube

Westinghouse Electric Corporation, makers of all Apollo spacecraft television cameras, has developed a new TV camera tube with a heat-resistant target to prevent failure if the camera is accidentally pointed directly at the sun as occurred during the Apollo 12 mission. The Apollo camera tubes use a process called secondary electron conduction (SEC). This takes place in a thin, three-layer target in which an electron image is produced, stored and read out as a TV signal. Conventional SEC targets consist of layers of aluminium oxide, aluminium, and potassium chloride. The new tube substitutes a fine metal screen for the aluminium oxide as a support layer. This acts as a heat sink allowing the tube to be exposed to images 100,000 times brighter than normal operating levels without burn-out.

Pictured against an Apollo rocket, a Westinghouse heat-resistant TV camera tube for use on future Apollo missions.

Canadian transmitter

Canada's first high-power UHF television transmitter will be installed in Toronto jointly by the Canadian Broadcasting Corporation and Marconi this year. The contract, worth $200,000, was awarded to the Marconi Broadcasting Division through the agency of the Canadian Marconi Company. The 55KW transmitter will be owned and operated by C.B.C., and leased to the Ontario Department of Education. The Department will use the transmitter for the country's first full-time educational television channel to be inaugurated on September 1, this year.

Explorer 1 returns

The first U.S. satellite in space, Explorer 1, re-entered the earth's atmosphere over the South Pacific on March 31 this year. It was launched on January 31, 1958 on a Jupiter-C rocket from Cape Canaveral, Fla. Data from this first flight established the presence of the Van Allen radiation belts around the earth. Before its final plunge, the 30.8 pound satellite had completed more than 58,000 revolutions of the earth. Its original orbit was 224 by 1,573 miles; its orbit shortly before re-entry was 90 by 130 miles.

The West German satellite control centre showing the large map which indicates the position of the satellite at any time.

Cuban satellite link

The U.S.S.R. is to build a communications satellite earth station in Cuba to work into the Russian Molniya satellite system. Apart from its communications use, the link will permit the exchange of radio and television programs between the two countries.

Satellite stabilisation

The Australis Oscar V satellite, launched earlier this year, is stabilised by a system of Plessey Rola magnets and hysteresis rods which aligns the satellite with the earth's geomagnetic field. Stabilisation is an important factor in reducing signal fading due to tumbling. The effectiveness of the system is indicated by signals received over the channel corresponding to the x-axis horizon sensor which indicate a lower rate of spin as the satellite comes into alignment with the earth's magnetic field.

Cassette data store

An incremental storage device, developed by Recording Designs Ltd. of the U.K., can record and playback digital data from any source using standard ¼in tape cassettes. The cassettes have a life of some 500 passes, and each tape can be filled with 50,000 8-bit characters. Called the GED 450, the instrument is capable of transmission over telephone lines at speeds of 50, 75 or 100 bauds. The GED 450 can handle data inputs at up to 20 characters per second incrementally. It has step and repeat, search and edit facilities enabling it to stop on any character, and it can be left on any character. (Recording Designs Ltd., Blackwater Station Estate, Camberley, Surrey, England.)

Freda Polanski just added a new note to Beethoven's Fifth.

Poor Freda.

There was the orchestra giving a sensitive performance of the third movement.

And there was Freda giving a repeat performance of the pickle and liverwurst sandwich she'd had for lunch.

Years ago it wouldn't have mattered a bit. Sound equipment didn't have such sharp ears then. But today there's Wharfedale. And an orchestra can't afford to put a single note wrong. Wharfedale is quite simply the most sensitive speaker in the world.

Choose any size.

Put it in any cabinet. (And there's a wide and handsome range). And just listen. You'll be amazed at the fantastic improvement in the audio quality of your hi-fi or tape sound system.

If it's on the record, you'll hear it with a Wharfedale.

Isn't that right, Freda?

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Australian National Distributors: Simon Gray Pty. Ltd. **Head Office:** 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101. **Sydney:** 22 Ridge St., North Sydney, N.S.W. Tel. 929 6816. **Canberra:** 31-33 London Circuit, Canberra City, A.C.T. Tel. 49 6050. **Queensland:** Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422. **S.A.:** Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844. **Tasmania:** K. W. McCulloch Pty. Ltd., 57 George St., Launceston. Tel. 2 5322. **W.A.:** Athol M. Hill, 613-615 Wellington St., Perth. Tel. 21 7861. **N.T.:** Pfitzner's Music House, Smith St., Darwin. Tel. 3801.

SPASM1355/SCM

Post graduate courses

The remainder of the 1970 program of courses to be presented by the Division of Post-graduate Extension Studies of the University of New South Wales includes:

June: Social psychology of communication II; Computer programming.

July: Marketing statistics; taxation law.

August: Art and practice of written and spoken communication I; Colour television; Instructional film production.

September: Factory design and layout; Human communication systems; Video equipment; Computer systems analysis and design.

November: PERT and CPM II; Art and practice of written and spoken communication II; Building finance; Computers at work II; Operations research I; Management psychology; Pharmacy refresher course III.

Attended lectures or tutorials will be held at Kensington or the City. Radio lectures will be broadcast over Radio University VL2UV. Television lectures will be transmitted over Television University V1TU, and viewing centres are available at Kensington, the City, Pymble, Carlingford, and Cremorne. Generally, the courses over Radio University will also be available through the Division's Tape Correspondence Service.

Details of the courses may be obtained from the Division of Post-graduate Extension Studies, P.O. Box 1, Kensington, N.S.W. 2033. Telephone Sydney 663 0351, extension 2691.

Trans-Atlantic cable

At the invitation of the Spanish authorities, Mr M. Mili, Secretary-General of the International Telecommunication Union (I.T.U.), took part in the official inauguration of the TAT-5 trans-Atlantic telephone cable at Cadiz, Spain, on April 9, 1970. It has a capacity of 720 telephone channels, the largest of any trans-Atlantic cable to date. The first cable, laid in 1956, had a capacity of 50 channels; TAT-4, laid in 1965, provided 128 channels. The inauguration preceded by a few days that of the second antenna for the Spanish earth station at Buitrago, which is used for satellite communications.

Binocular head-up display

Elliott Flight Automation Ltd. of the U.K. has developed a true binocular head-up display which is under evaluation at the Royal Aircraft Establishment at Farnborough. The system projects two identical groups of symbols from two parallel cathode-ray tubes on to a wide, shallow reflector placed close to the pilot's eyes. The two groups are aligned so that they appear to the pilot as a single image. The main advantages claimed for the system are that it provides a wider than usual field of view using very compact equipment, and that it is shallow enough to be mounted in the cockpit ceiling close to the pilot's head.

Mapping mineral resources

NASA has awarded a $1.1 million contract to ITT's Aerospace/Optical Division in the U.S.A. to design and deliver a high-resolution surface-composition mapping radiometer for the Nimbus-E satellite to be launched in late 1971. The instrument will provide a new method of mapping earth resources, determining the composition of the earth's mineral formations by measuring residual infrared radiation. Infrared detectors will scan the earth through an 8in telescope and will pinpoint earth emission within 650 yards according to ITT and NASA.

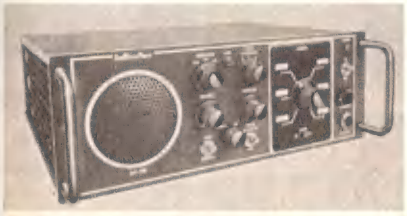
Joint editorial board

Members of the U.S.A.-U.S.S.R. Editorial Board responsible for preparing and publishing a joint review of space biology and medicine met in Moscow on April 9-10. The purpose of the meeting was to select authors for the chapters covering reference materials exchanged in January, and to agree cn procedures and schedules for carrying out the project.

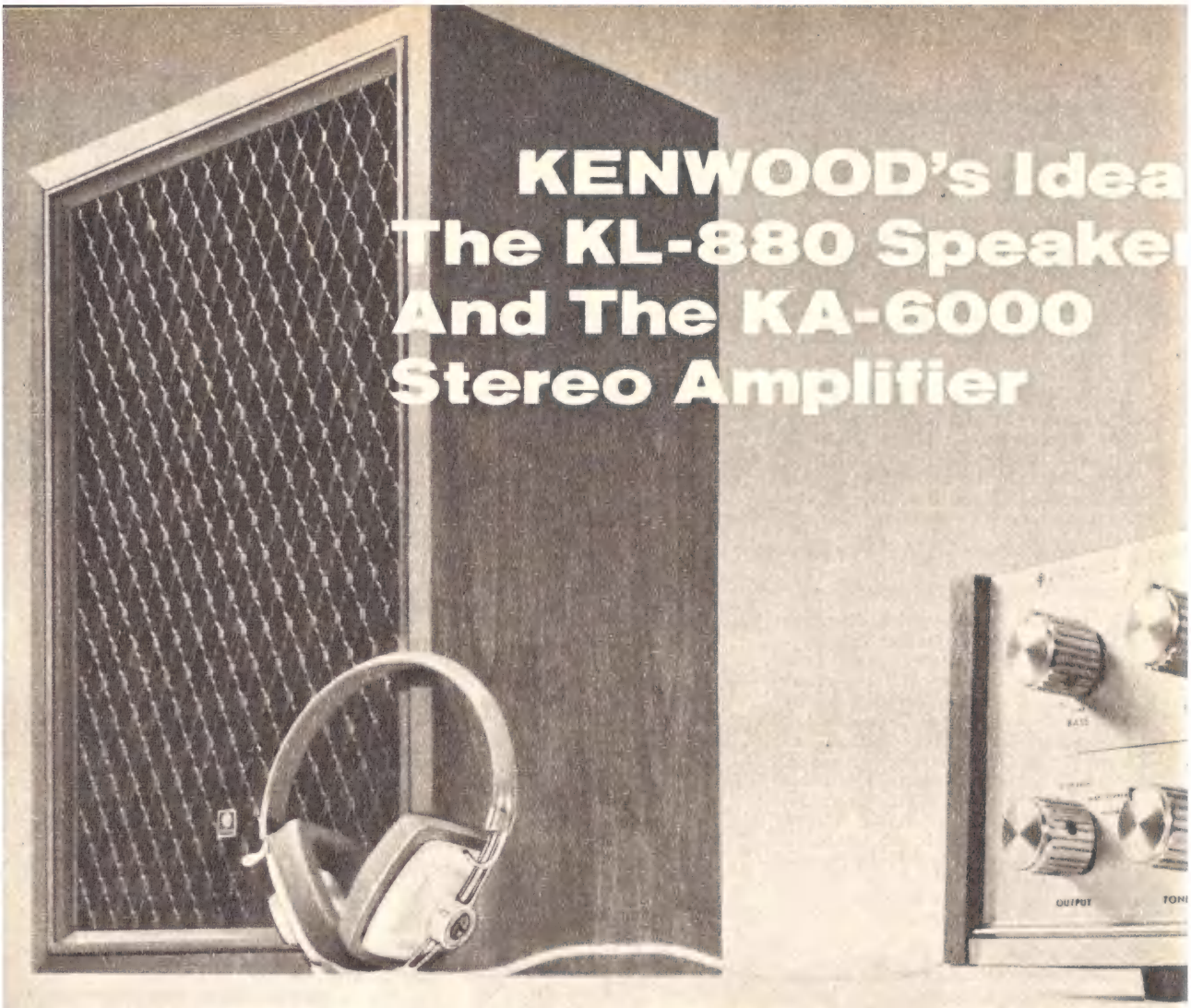
Communications transceiver

The Hallicrafters SBT-100 transceiver has been designed and manufactured specifically for rugged applications demanding high reliability and operation over wide extremes of humidity and temperature. Suitable for mobile, base, marine or aircraft installation, the equipment has a choice of five operating modes: USB, LSB, CW, AM, and external FSK. It is a fixed channel unit with up to six crystal-controlled channels in the 2 to 18MHz frequency range. A built-in universal power supply is changed from 117 or 234V AC (50 or 60Hz) to 12V DC by selection of the appropriate plug-in power cable.

The SBT-100 includes the following built-in features as standard equipment: VOX, CW with side-tone monitoring, squelch, noise blanker, speech processing and clipping, power and output indicators, AGC, ALC, antenna switching with coaxial connectors, weather sealed heavy-duty loudspeaker, and voice clarifier. A wide range of accessories are available including: mobile mounting rack, remote control head, telegraph key, microphone, handset, single channel antenna tuner, 6-channel switchable (manual or remote) antenna tuner, test set, SSB-FM interface repeater, and numerous antennae. (The Hallicrafters Co., 600 Hicks Road, Rolling Meadows, Ill. 60008, U.S.A.)



The Hallicrafters SBT-100 transceiver.



KENWOOD's Idea
The KL-880 Speaker
And The KA-6000
Stereo Amplifier

SPEAKER SYSTEM
KL-880

HEAD PHONE
HS-3

Perfect performance mates—that's KENWOOD's KL-880 4-way, 5-speaker system and the KA-6000 stereo amplifier.
Sound as it really is—not as it almost is. That's an extra you get because the KL-880 has a 15-inch free-edge woofer, a 5-inch cone type midrange and horn type high midrange squawkers.
Add two horn type tweeters and KENWOOD provides you with amazing ultra-angle treble dispersion.

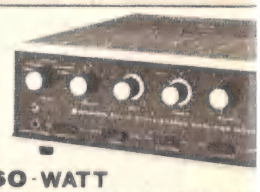
The KA-6000 is a power-packed 180-watt stereo amplifier that drives life into Hi-Fi speakers of lowest possible efficiency.
Combined with the KL-880 they're an unbeatable stereo team.
There's wide power bandwidth of 10Hz to 50,000Hz with low-low IM distortion.
And the KA-6000 has exclusive low level phono inputs for low level output phono cartridges of 2mV, 0.5mV or 0.05mV.
For personal, exclusive enjoyment there's

120-WATT SOLID STATE STEREO AMPLIFIER KA-4000

* The wide power bandwidth of 13Hz to 30,000Hz with very low IM distortion.
* Lever type-20dB muting switch of quick response for momentary quiteness during telephone call, etc.
* Dimensions: 16-5/16"(W), 5-5/32"(H), 11-1/32"(H)

40-WATT SOLID STATE STEREO AMPLIFIER TK-150U

* 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
* Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
* Dimensions: 10-1/4"(W), 4-1/8"(H), 9-3/8"(D)



60-WATT SOLID STATE STEREO AMPLIFIER TK-250U

* 2 sets of stereo speaker terminals and front panel speaker selector switch.
* Dimensions: 13"(W), 4-1/8"(H), 9-15/16"(D)

180-WATT SOLID STATE STEREO AMPLIFIER KA-6000

the HS-3 headphone accessory.
So, put these KENWOOD giants together and add true stereo enjoyment to your life.
KENWOOD has a distinguished array of models operating with less power, but at top quality.

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30-WATT
FET SOLID STATE AM/FM STEREO RECEIVER TK-20U

* F.E.T. (Field Effect Transistor) 3-Gang Tuning Condenser frontend for superior sensitivity, image rejection and cross modulation ratio.
* Dimensions: 14-1/16"(W), 4-3/4"(H), 11-1/4"(D)

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Send me information on KENWOOD RECEIVERS, AMPLIFIERS, SPEAKERS & name of nearest KENWOOD retailer,

NAME: _____ AGE: _____

ADDRESS: _____

A low cost 70MHz Digital Frequency Meter . . . 2

This article continues and completes the description of the high-frequency version of our new digital counter-frequency meter design, following on from last month's article. It also discusses the adjustment and calibration of the completed instrument.

by Jamieson Rowe

The remaining wiring board of the instrument to be described is that which mounts the quartz crystal oscillator and frequency divider chain. This board is in fact that described previously in the author's article dealing with the "Solid State Frequency Calibrator," published in the September, 1969, issue. The circuit/logic diagram of the board is shown in figure 6.

As may be seen the crystal oscillator is a locked multivibrator type, using both sections of a Motorola dual buffer type MC799P (IC30). A capacitor/trimmer combination connected in series with the crystal provides the vernier adjustment to allow the oscillator to be calibrated against an external reference.

The crystal used in the oscillator is a "D-type" unit, having a nominal frequency of 2MHz. This frequency has been chosen as it would appear to offer a very favourable performance/cost compromise. The crystal used in the prototype instrument is an AT-cut type with an adjustment tolerance of .003 per cent, specified for operation at ambient temperatures. It was kindly supplied by Pye Pty. Ltd., who advise that similar units can be supplied to readers on order, either direct or via normal parts supplies. The Pye designation code for the unit is type "FEF," with the holder code "Q12A" and the nominal intended shunt capacitance 30pF.

The output from the 2MHz crystal oscillator is fed to both elements of IC31, which is a Motorola type MC790P dual J-K flip-flop. One element of IC31 provides the buffered 1MHz signal output of the board, while the other element feeds a similar 1MHz signal to the first divider decade.

The first divider decade consists of four J-K flip-flop elements, provided by devices IC32 and IC33. These and the remaining 10 devices on the board are all Motorola dual J-K flip-flops type MC790P.

The configuration used for the first divider decade is shown in figure 6. The first element is used as a 2:1 divider, giving half the input frequency, while the remaining three elements are wired in an economical self-gating configuration which gives a further 5:1 division. The first divider decade thus provides both 500KHz and 100KHz outputs, but only the 100KHz output is used in this instrument.

The remaining 10 microcircuits on the timebase board are wired in five further decade divider stages, each of which is identical to the first divider decade. These decades provide output frequencies of 50KHz, 10KHz, 5KHz, 1KHz, 500Hz, 100Hz, 50Hz, 10Hz, 5Hz and 1Hz, and all of these are used in the present instrument with the exception of the 100Hz and 10Hz signals.

The wiring diagram for the timebase board is shown in figure 7. As before the wiring and interconnection of the board should be found straightforward if this diagram is used in conjunction with that of figure 6. All the components required will be found in the parts list given last month.

Note that all wire links and bypass capacitors mounted on the board must be fitted. The links are essential for continuity of the supply line while the bypass capacitors ensure that operation of the microcircuits is not disturbed by supply line transients.

The NPO ceramic trimmer which forms the calibration adjustment for the crystal oscillator is a special type designed for printed-board mounting and side adjustment. The unit employed in the prototype and for which the printed board has been designed is marketed in Australia by the Imported Components Division of Plessey Ducon Pty. Ltd., and may be ordered via normal parts suppliers. The type number is DV11-PR8A.

The power supply section of the instrument is fairly conventional, as may be seen from figure 8. A simple half-wave rectifier circuit using a 150V/20mA transformer secondary winding is used to provide approximately 200V at low current for the readout display tubes, while a full-wave bridge rectifier circuit using a centre-tapped 12.6V/4A winding is used to provide supplies of +5V, +4V and −5V for the various microcircuits.

The low-voltage bridge rectifier is a single-package silicon unit, type PA40, by Electronic Devices Inc., of New York. It is available either directly or via trade suppliers from Watkin Wynne Pty. Ltd., who act on behalf of Australian General Electric Pty. Ltd., the importers. Watkin Wynne are also able to supply the transient-protected A14M diode used in the 200V supply.

The reservoir capacitors for the low-voltage supplies are bracket-mounted 3000uF units, this value being necessary because of the appreciable current drain. These and the other capacitors used in the prototype power supply were kindly supplied by Plessey Ducon Pty. Ltd. Readers may order similar units from this firm, through their usual trade supplier.

Both the positive and negative outputs of the low voltage power supply are stabilised by means of simple series regulator circuits. The regulators are very similar, and use BZY88/C6V2 nominal 6.2V zener diodes in conjunction with BDY20/2N3055 series regulator transistors. The main difference between the two is that in the positive supply an AY8115 or 40408 device is used in conjunction with the main transistor in a Darlington or "super-alpha" pair, for high current gain, whereas in the negative supply the reversed polarities require the use of a "complementary compound" configuration using a TT3638 PNP device.

The −5V output from the supply is used for the ECL devices on the counting board, and for IC18 on the input board. The +5V supply is used for the

Front view of the new instrument, whose full specifications were given last month. As a frequency meter, it performs measurements to beyond 70MHz. Most of the reference frequencies generated by the internal crystal timebase system are made available externally for receiver calibration and similar purposes.

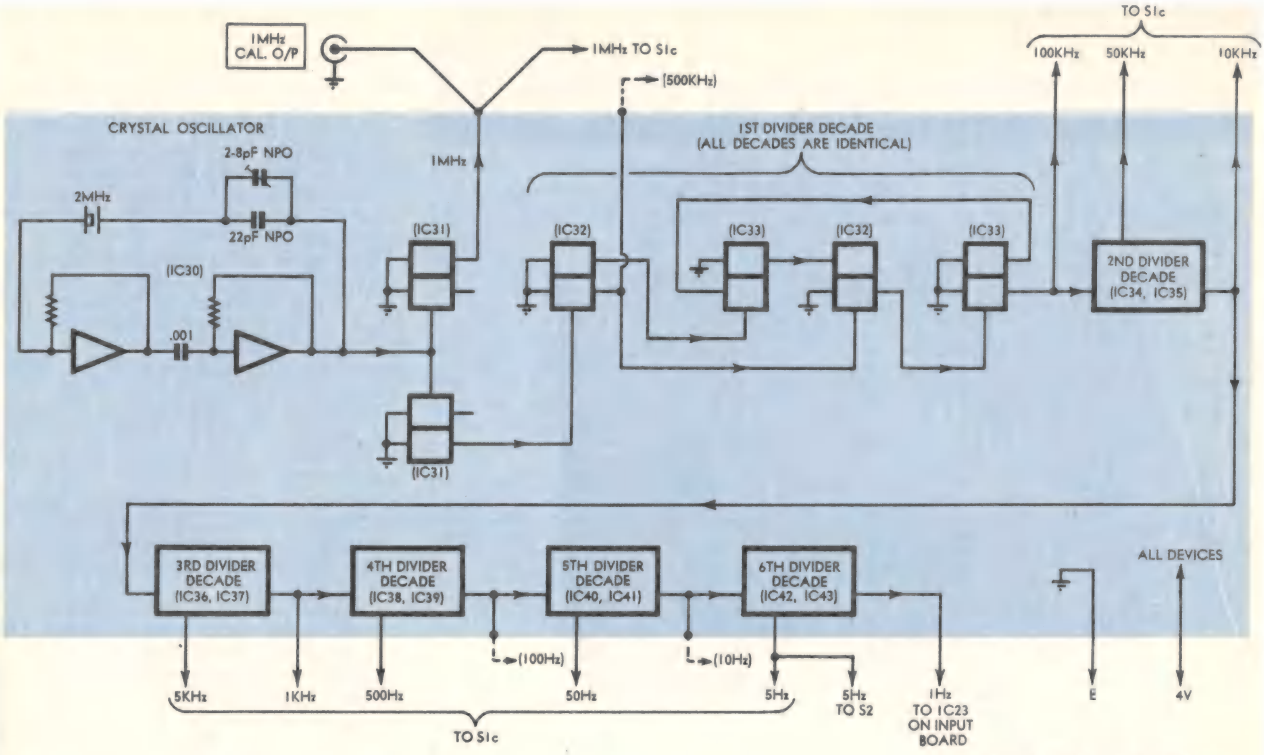

Figure 6 — 70MHz DIGITAL FREQUENCY METER — TIMEBASE BOARD

BLUE OVERPRINT INDICATES PRINTED WIRING BOARD (69/c9)

DTL devices on the counting board, for the level translation ECL devices, and for the front panel pilot lamps. As the +5V supply would cause excessive dissipation if applied to the RTL devices, a simple series-diode system is used to derive approximately +4V for these devices.

The power transformer used for the instrument is a rather special type, combining a low-current high voltage secondary with a high-current low voltage winding. The prototype transformer was kindly supplied by Ferguson Transformers Pty. Ltd., from whom similar units may be ordered via trade suppliers. The type number which has been assigned to the unit is PF 3144.

To assist constructors in wiring the power supply section of the instrument, we have prepared a wiring diagram for the 10-lug section of miniature resistor panel which supports most of the minor components. This is shown in figure 9. The remaining components should be visible in the interior photographs, while the remaining wiring is quite straightforward.

Like the 200KHz version, the new instrument is housed in a simple low-cost metal case which is identical in style and external dimensions to that of our "10-Plus-10 Stereo Amplifier." The prototype case was kindly supplied by Heating Systems Pty. Ltd., who should be able to supply drilled and punched cases and front panels soon after this article appears.

As may be seen from the photographs, the front of the instrument is fitted with an escutcheon plate having a rectangular window for the readout display. The window is provided with an optical filter made from orange-tinted "Perspex" sheet, the later being bolted to and behind the front panel proper by means of countersunk-head screws hidden behind the escutcheon.

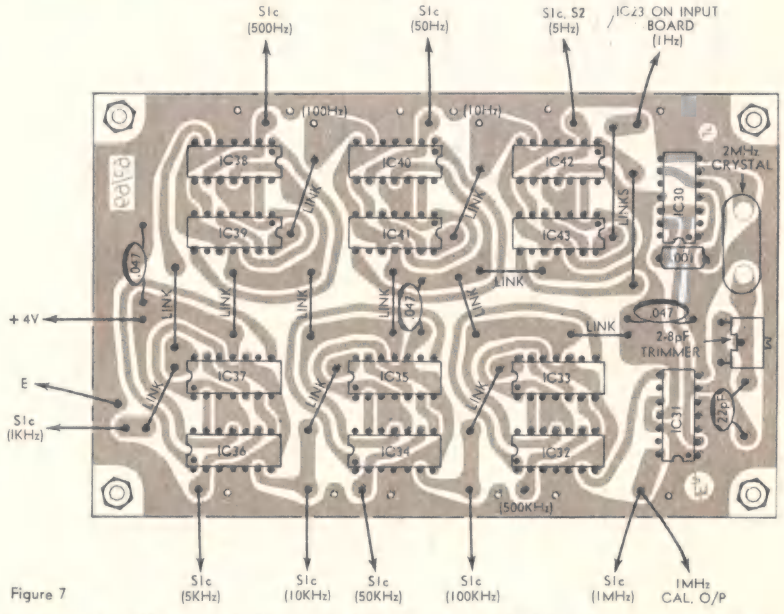

Figure 7

Beneath the display window on the front panel are mounted the mains pilot, gate indicator and overflow lamps, and below these again the mains switch, manual gating button and manual reset button. Adjacent to these is the mode switch, S2.

The pilot lamps, mains switch and manual pushbuttons are all miniature types. The pilot lamps are Japanese "Sato" components, and may be ordered via trade suppliers from either I.R.H. Components Ltd. or the Imported Components Division of Plessey Ducon Pty. Ltd. The mains pilot has a green bezel, while the other two have red bezels.

The mains switch and push-buttons are from the Japanese "NKK" range, and may also be ordered via trade suppliers from I.R.H. Components Limited. The mains switch is coded type S-2012, while the buttons are coded type SB-2061.

To the right of the display window on the front panel are the range switch S1 and the sensitivity control, in that order. Mounted centrally beneath these controls is the input connector and AC-DC coupling selector switch, completing the front panel fittings.

Mounted on the exterior of the case rear are the mains cord entry and the power fuse-holder, the two power supply regulator transistors (insulated by mica washers), and at the far right the connectors for 1MHz calibration, selectable calibrate output, and external sampling input. The silicon rectifier bridge and 3000uF reservoir capacitors are mounted on the rear of the case also, but are inside.

The power transformer is mounted near the rear of the case, adjacent to the regulator transistors. Between the transformer and the reservoir capacitors is the 10-lug section of miniature resistor panel used to support the minor components of the low voltage power supply. The few components of the high-voltage supply are mounted on a 4-lug tagstrip on the other side of the reservoir capacitors, near the rear-panel connectors.

The input circuitry wiring board is mounted immediately to the front of the power transformer, behind the range switch S1 and the sensitivity pot. The small divider board is mounted above the right-hand end of the input board, as viewed from the front. The timebase board is mounted alongside the input board, to the left, behind the mains switch, pushbuttons and mode switch S2. The counter board is mounted above the timebase board, supported by long screws in a position such that the numerals of the readout tubes are centrally placed behind the display window.

Construction of the instrument should present few problems even for the relatively inexperienced constructor. The component placement on the printed wiring boards is shown in the diagrams, as are also the board interconnections and most of the "hand" wiring. However, there are a few minor

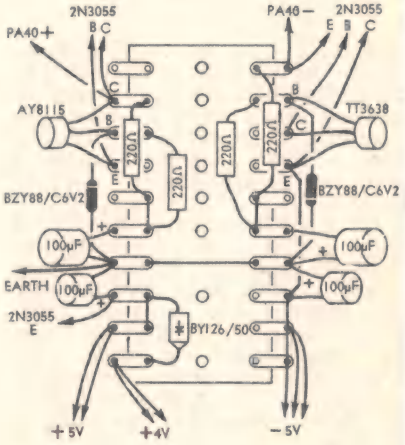

Figure 9

points regarding which it may be worthwhile to present the following brief comments.

A soldering iron having a small, well-tinned bit is recommended for making the soldered joints to the printed wiring boards, as this will allow the joints to be made without risk of bridging between conductors. The joints should be made rapidly, particularly those involving microcircuits and other semiconductor components, to prevent damage due to overheating.

The flying leads of the numerical indicator tubes and over-range neon should be bent very carefully to line up with the holes in the counter board, in order to prevent strain on the glass envelope.

Note that the correct orientation for the 14-pin and 16-pin microcircuits is shown in the wiring diagrams by a small hemispherical indentation on the device symbol. It will be found that each device has a similar indentation at one end of the package. The round 8-pin devices have a flat or coloured

line whose orientation is indicated in the diagrams.

Note also that there are two reset signal inputs to the counter board, the two being joined by a long link of insulated hook-up wire.

The mains cord should be securely clamped to the case floor, after entry via a suitably grommetted hole, using a "C" clamp. This will prevent strain on the connections. The connections themselves are best made using a 3-segment length of "B-B" connector strip, which may be mounted to the right of the power transformer.

Signal interconnections between the various boards should be made in standard insulated hookup wire, and arranged to be as short and as direct as possible. Shielded leads need only be used for the connections to the three rear-panel connectors.

And finally, take care when mounting the two power supply regulator transistors to ensure that the device cases are properly insulated electrically from the instrument case. Use the standard mica insulating washers, with a smear of silicone grease on each side for thermal continuity, and fit the usual fibre or plastic sleeves to the mounting bolts. It is a wise precaution to check the insulation with an ohmmeter when the device is mounted to prevent possible damage when power is applied.

There are only two adjustments to be made upon completion of the counter, after which it should be ready for immediate use. The first adjustment required is that whereby the "preset sensitivity" pot on the input board is set so that maximum input sensitivity occurs when the front panel control is in the fully clockwise position.

This adjustment is quite easily made, according to the following procedure. Initially set the front-panel control to the fully clockwise (minimum resistance) position, and the preset control also to the fully clockwise position (maximum resistance) looking from the right-hand side of the instrument. Then, with no input signal applied, and with the range and mode switches set to the "200KHz" and "5/S" settings respectively, the instrument should read "000."

It should be found that if the preset control is slowly turned back anticlockwise (reducing the resistance), a point is reached where the readout display will change from "000" to "001." The correct setting of the preset pot is right at this change-over point.

In other words, the preset should be adjusted so that the display just changes from "000" to "001" as the front-panel control is turned to the fully clockwise position.

The second and final adjustment to the completed instrument is that involving calibration of the crystal timebase against an external frequency standard. This operation is performed by adjustment of the small ceramic trimmer on the timebase board, using a small insulated alignment tool introduced through a small hole in the side of the instrument case.

Two methods of calibration may be used. One simply involves measurement of the 1MHz output of the instrument using an existing high-accuracy digital frequency meter. This is a very efficient technique, and will no doubt appeal to those with the appropriate facilities. However, it should be noted that the frequency meter used should be one having a timebase system whose accuracy and stability are at least within 1 part per million, otherwise the exercise will have little validity. The reason for this is that the crystal timebase of the new instrument is itself likely to have a performance approaching 10 parts per million, when set up.

The electrical setup for the alternative method of calibration is almost as simple, and may be more convenient. It involves only a conventional shortwave or communications receiver capable of

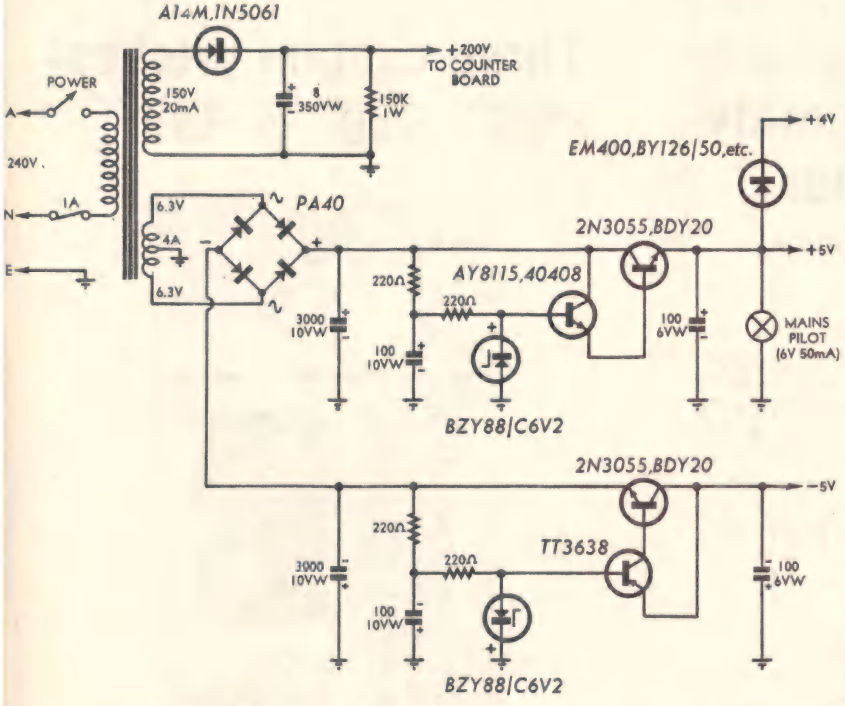

Figure 8 — 70MHz DIGITAL FREQUENCY METER — POWER SUPPLY

Made in Australia

McMurdo Red Line modular edge connectors

Available ex stock for fast assembly to customer specifications

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Moulding	Polypropylene (red)
Contacts	Phosphor bronze
Finish	Gold plate or tintillate
Polarising key	Nickel plated
Mounting brackets	Nickel plated
No. of contacts & pitch	Up to 40 (no brackets) .100"
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Insulation resistance	DC 500V. 5000 mOhms or more
Electrical strength	100v/mil.
Contact resistance	6 milliOhms or less
Contact rating	5 amps

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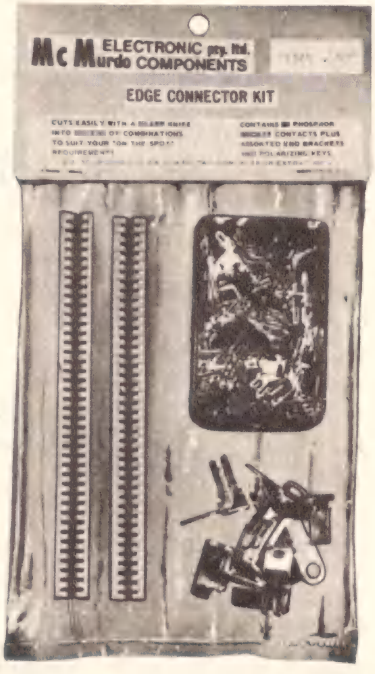
Three contact pitches – ·100", ·150" & ·156"



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McM-8

receiving a standard frequency transmission, such as those radiated by station WWV on 2.5, 5.0, 10.0, 15.0, 20.0 and 25.0MHz, by station WWVH on 5.0, 10.0 and 15.0MHz, or by the P.M.G. station VNG at Lyndhurst Victoria, on 4.0, 7.5 and 12.0MHz. The 1MHz signal from the frequency meter is simply fed into a rudimentary aerial near the receiver, and the timebase trimmer adjusted for zero beat.

The procedure is to switch both the frequency meter and the receiver on and let them run for about 15 minutes to allow the case temperatures to stabilise. At this stage no connection should be made to the output connectors of the frequency meter, in order that radiation should be minimal. Then tune the receiver carefully to whichever of the standard frequency signals is currently available at a level adequate for convenient and reliable reception.

A foot or two of hookup wire may then be inserted into the 1MHz output connector, whereupon a beat note should become audible in the receiver output. It may in some cases be necessary to place the wire close to the receiver aerial lead-in, or perhaps even twist the two together, in order to obtain sufficient coupling.

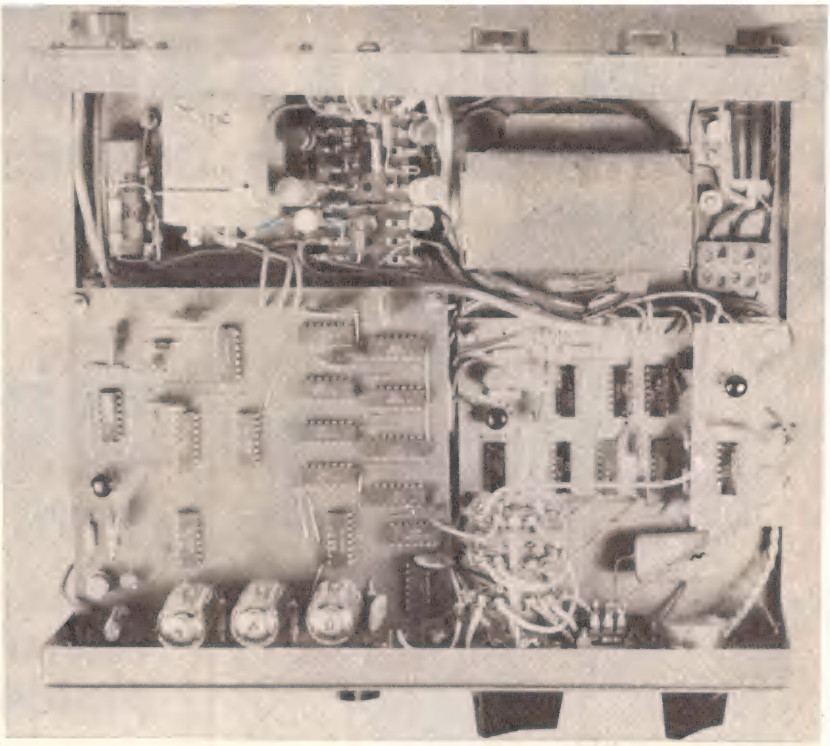
Adjustment of the timebase trimmer should allow the beat note to be reduced i nfrequency below audibility, although continued turning of the trimmer in the same direction should result in the note re-appearing and rising in pitch once again. The zero-beat condition lies in the centre of the inaudible-beat segment of adjustment and with many receivers it may have to be estimated by interpolation. However, if the receiver is fitted with an "S" meter it should be possible to observe the beats on the meter when they are near zero, and a more accurate setting may be achieved.

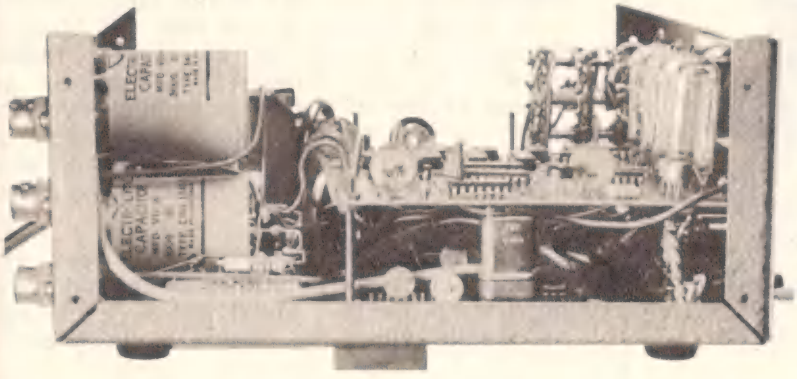
Once set up in this fashion the instrument should retain its calibration for a considerable period. The oscillator circuit is relatively insensitive to temperature, and is also free from many of the aging effects which are found with other circuits. However, before critical measurements are to be made using the instrument, it would be wise to re-check its calibration using the above techniques.

Operation of the instrument is quite straightforward, and should be largely self-evident from the controls. The main point to watch is that the sampling rate used must not conflict with the gating time of the range in use, for if the two conflict, it will not be possible to obtain sensible readings.

In practice either of the two internal sampling rates, or any externally derived rate up to about 30Hz may be used for the 200KHz and higher frequency ranges, but only the lower of the internal rates may be used for the 2KHz and 20KHz ranges. Which sampling rate may be used for the time-period ranges depends upon the signal being measured, as noted earlier.

If the "overflow" lamp lights when performing a measurement, the instrument should in general be turned to a higher range in order to read the most significant digits. Conversely if it is desired to read the less significant digits of a measurement, these may be effectively "shifted up" into the display by turning to a lower range ("down-ranging"). The overflow lamp will naturally light in the latter case, but this will merely indicate to the operator that the digits displayed are not those of most significance. ■





Above is a top view of the interior of the counter, showing the board layout. At left is a side view showing the crystal timebase board, located beneath the counter board.

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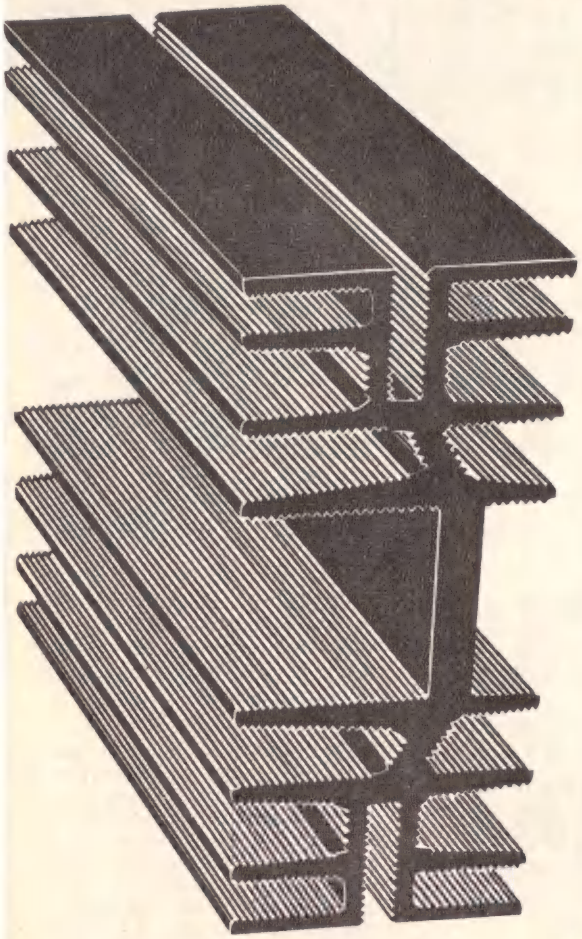

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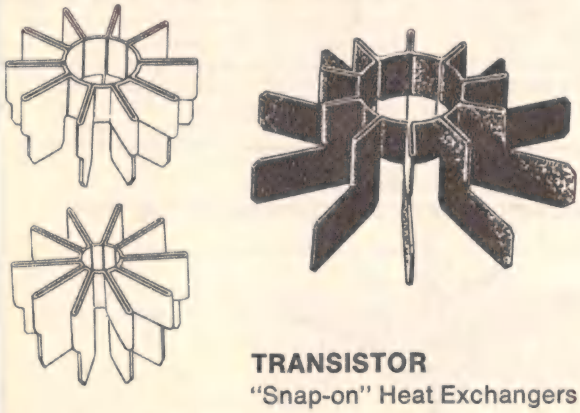

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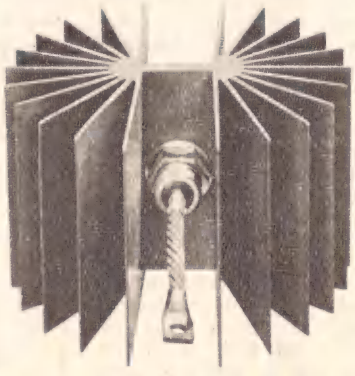

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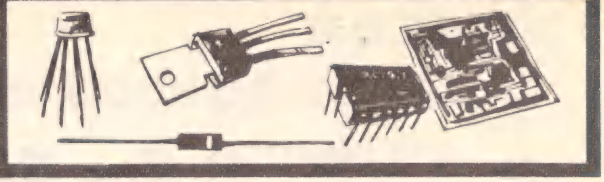
Fundamentals of SOLID STATE



Chapter 13

by Jamieson Rowe

Electronic switching, and the bipolar transistor — the OFF state, and the effect of transistor leakage — the ON state — saturated and unsaturated operation — device power dissipation — speed of response — delay, rise, storage and fall times — improving response speed — current mode switching — switching applications.

In addition to the multitude of linear circuit applications for which they prove suitable, bipolar transistors also have many applications in switching circuitry. In this chapter we will examine those aspects of device behaviour which are of basic importance in switching applications, and will then look briefly at some of the more commonly encountered applications of this type.

As the reader might well expect, it is normally desirable that any electronic device used to perform switching in a circuit should provide as close an approximation as possible to an "ideal" switching element. Hence in general such a device should exhibit as high a resistance as possible in its "switch open" or OFF state, and as low a resistance as possible in its alternative "switch closed" or ON state. Together with these basic requirements it should also possess the ability to be switched between these two states, in either direction, in as short a time as possible, as reliably as possible, and when so commanded by a control or "drive" signal for which the power requirements are relatively modest.

By suitable control of fabrication processes, the parameters of bipolar transistors can in general be arranged to meet these requirements rather well. When in the non-conducting or cutoff condition, a bipolar device typically exhibits a very high collector-emitter resistance, and thus provides a good approximation of an "open" switch. On the other hand, its resistance when in heavy conduction is usually quite low, giving an almost equally good approximation to a "closed" switch. And with a suitably designed device the transitions between these two states can be made reliably in a very short time, under the control of a relatively small input bias signal.

In basic terms, a bipolar transistor is used as a switch in exactly the same way as one uses a switch of the familiar mechanical variety: by simply connecting it across the source of supply, in series with the load whose current is to be switched on and off. In practice the load is connected in series with the collector, as shown in figure 13.1, with the transistor turned on and off by means of bias signals applied to the base via a series resistor Rb.

At this stage of our discussion of the bipolar transistor it should be almost unnecessary to point out that while an NPN transistor is shown in figure 13.1, the identical configuration is used with PNP devices. The only changes necessary if a PNP device is used are the usual reversal of supply and bias voltage polarities.

Essentially the operation of this basic circuit is quite straightforward. With zero bias or a reverse bias —Vbo applied to the base via Rb, the device is cut off and draws negligible current; this is thus the OFF state of the circuit. Alternatively with a suitable forward bias Vbf applied to the base via Rb, the device conducts heavily and exhibits a low voltage drop; this is thus the ON state of the circuit.

As a bipolar transistor is a "normally off" device, it is at least nominally cut off with zero external bias applied to the emitter junction. However as we have seen in preceding chapters, a small collector-emitter current still flows when external forward bias is removed from the emitter junction, namely Iceo. This is an amplified version of the collector junction leakage current Icbo, and is accordingly dependent upon the semiconductor material involved, the temperature, the gain factor beta, and the resistance of the external circuit connected between base and emitter.

In theory, the mere existence of Iceo makes the bipolar transistor an imperfect switch, because it implies that the device never turns completely "off." However in practice the significance of Iceo depends very much upon its magnitude compared with the load current passing through the device in the ON state.

It is in cases where Iceo would be significant in comparison with the ON state current that it becomes particularly necessary to apply a reverse bias-Vbo to the base in the OFF state. The effect of the reverse bias is to prevent the device from amplifying the collector junction leakage current. Hence, when the reverse bias is used, the OFF state collector current passed by the device is not Iceo, but the considerably smaller Icbo.

Broadly speaking, from the point of view of minimum OFF state current, the very small value of Iceo passed by silicon devices makes it unnecessary to apply reverse bias when these devices are used, at least in applications which do not involve operation at high temperatures. In contrast it is usually necessary to apply reverse bias with germanium devices even at normal operating temperatures, because of the higher Iceo levels of these devices. However, with devices made from both silicon and germanium it is often desirable to apply reverse bias in the interests of operating speed, as will be explained later.

The OFF state of a bipolar transistor switch almost always corresponds to the situation where the device is at nominal cutoff. And as one might expect, the ON state always corresponds to a contrasting situation where the device is forward biased and conducting heavily. However, two different types of ON state operating point are possible: one is where the device has been driven completely into saturation, the other where the device is arranged to conduct heavily without quite entering the saturation region. Both of these types of operating point are used in practical switching circuits.

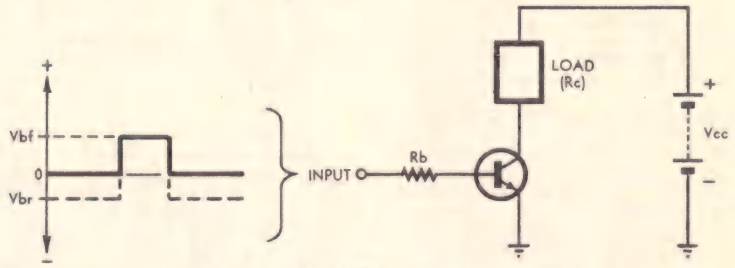


Figure 13.1

Circuits in which the devices are driven into saturation in the ON state are described as operating in the **saturated switching mode;** in contrast those which deliberately restrict the ON state operating point just short of saturation are described as operating in the **unsaturated switching mode.** Each of these modes of switching are illustrated graphically in figure 13.2.

In the saturated switching mode, as shown in (a), the forward bias Vbf applied to the base of the device via Rb is such that in the ON state the device operating point slides right up to

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FCS-200	8	60~20,000	40	200(W), 50(T)	530H×294W×240D
FCS-207	8	45~20,000	30	200(W), 50(T)	540H×295W×220D
FCS-208	8	70~20,000	30	200(W), 50(T)	480H×280W×200D
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DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
100	4	**FE-103**	8/16	65~ 95	f_0~18,000	96	10
160	6½	**FE-163**	8/16	40~ 60	f_0~20,000	98	10
200	8	**FE-203**	8/16	35~ 55	f_0~16,000	100	15
200	8	**FE-201**	8/16	60~ 90	f_0~16,000	100	8

WOOFERS

DIAMETER [mm]	DIAMETER [in.]	MODEL No.	V.C. IMP. [Ω]	RESONANT FREQ.(f_0) [c/s]	FREQ. RANGE [c/s]	SENSITIVITY [dB]	MAX. INPUT [W]
160	6½	**FW-162**	8/16	40~60	f_0~3,000	95	30
200	8	**FW-202**	8/16	25~35	f_0~2,000	97	45

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the intersection of the load line with the saturation locus of the device. The effective series resistance of the device thus falls to its minimum value, approximately equal to the "bulk" resistance of the collector-base and emitter regions.

When saturated, a bipolar transistor provides its closest approximation to a short circuit, and hence to an "ideal" switch in the closed position. It develops minimum voltage drop for the required load current, and hence wastes little power. Like cutoff, saturation is a low dissipation condition; in cutoff the device has relatively high voltage applied yet draws negligible current, whereas in saturation it passes considerable current yet develops negligible voltage drop.

Besides offering the advantage of low voltage drop and low power dissipation in the ON state, saturated mode switching also tends to be simpler and less costly than the alternative approach. Essentially only one additional component is required apart from the transistor itself and the load — the base resistor Rb.

The design of a saturated switch is generally quite straightforward: Rb and the forward bias Vbf are simply arranged to produce a base current Ib which exceeds that which would correspond to the required load current if the device were still in the active or "linear" region of operation. In other words, Ib is arranged to exceed the value of Ic(sat)/β, where Ic(sat) is the load current to be passed, and beta is the current gain of the device in the active region (strictly, the gain as measured just before saturation).

By Ohm's law Ic(sat) will be equal to (Vcc — Vce(sat))/Rc, where the term Vce(sat) is the saturation voltage drop of the transistor. Hence to ensure saturation, Ib must be arranged to satisfy the expression

$$Ib > \frac{Vcc - Vce(sat)}{\beta.Rc} \quad \ldots (13.1)$$

Usually Ib is arranged to be from 50% to 100% larger than the value of the right-hand side of this expression, when the latter is evaluated with beta equal to that of the lowest gain device likely to be used. This ensures that all devices should be reliably saturated.

Unfortunately, while saturated mode switching thus involves high static efficiency, low cost and relatively simple design, it also has the disadvantage of restricted operating speed. This is primarily due to the fact that, because of charge storage effects, a saturated bipolar transistor cannot cease conduction immediately upon removal of the base current drive. Further discussion of this phenomenon will follow shortly.

In contrast with saturated switching, unsaturated mode switching involves an ON state operating point which is near to, but not within, the saturation region. This is illustrated in figure 13.2 (b). While the collector current passed by the device is quite high and its voltage drop relatively low, operation is still in the "active" region where the device is capable of normal amplification action. Hence collector current Ic is still proportionally related to the base current Ib, according to the gain factor beta.

A device tends to dissipate higher power in the ON state of an unsaturated mode switching circuit than in a saturated mode circuit, because its voltage drop and effective resistance are both higher than if it were allowed to saturate. Hence in terms of static efficiency, an unsaturated mode switching circuit is less attractive than a saturated mode circuit.

The fact that the transistor is still "active" in the ON state of an unsaturated mode switch also produces an undesirable tendency for the load current to be dependent upon the gain of the device and the exact magnitude of its base drive signal, whereas ideally the load current should be determined solely by the load resistance and the supply voltage. Generally this means that unsaturated mode switching circuits cannot employ the simple circuit configuration of figure 13.1, but must employ more complex and more costly configurations which give adequate stabilisation against device and drive variations.

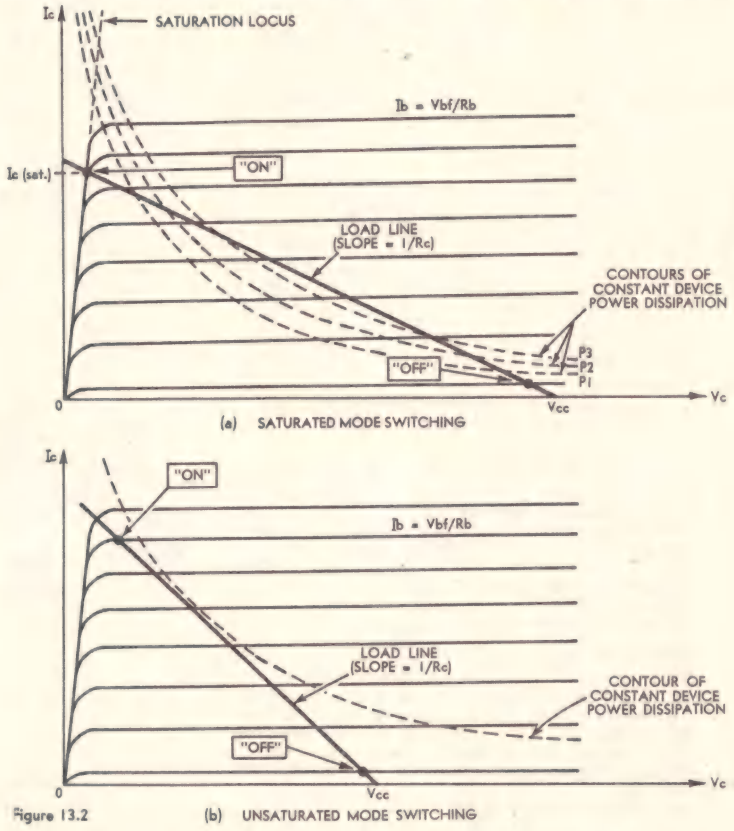

Figure 13.2

Despite these disadvantages, the unsaturated switching mode finds use because its offers the ability to operate at very high speeds. Because the transistor performing the switching is not driven into saturation, its operating speed for both turn-on and turn-off is basically only limited by the fundamental parameters which determine its "active" frequency response, and not by charge-storage effects. Unsaturated mode switching is thus used extensively in high-speed switching applications, particularly those where the ability to operate reliably at high speeds is very much less important than static efficiency or low cost.

In both the saturated switching and unsaturated switching modes, the power dissipation of the transistor tends to be relatively low in both the OFF and ON states. As a result it is generally true to say that switching circuitry tends to be relatively undemanding in terms of device dissipation rating. Quite small devices may be used even when appreciable power levels are involved in the load circuit.

While this is so, it is nevertheless true that in general the power dissipated by a bipolar transistor in a switching circuit tends to rise with the frequency with which switching operations are made. This follows because every time a device switches between the low-dissipation OFF and ON states, it necessarily spends a short but finite time in the intervening higher dissipation region.

It is in fact possible to draw contour lines on the collector characteristic of the device, representing constant device power dissipation, and examples of such contours are shown in figure 13.2. As may be seen the contours are of hyperbolic shape, corresponding to the fact that power dissipation is equal to the product of voltage and current. The distance between any contour and the Vc and Ic axes is directly proportional to the corresponding dissipation, so that in 13.2(a) contour P3 corresponds to a higher dissipation than P2, and P2 to a higher dissipation than P1.

The presence of the contours in figure 13.2(a) should allow the reader to verify the statement that a switching device necessarily passes through a region of relatively high dissipation in switching in either direction between the OFF and ON states. Note that whereas in both the OFF and ON states the device operating points are "below" the lowest dissipation contour P1, the load line crosses all three illustrated contours between these points, and for a significant part of its length is "above" the highest contour P3.

From this it may be appreciated that when a switching device is operated statically in either the OFF or ON

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ADC 660XE. Type: Induced Magnet; **Output:** 5 mV at 5.5 cms/sec. recorded velocity; **Tracking Force:** ¾ to 2 grams; **Frequency Response:** 10 Hz to 20 kHz ± 2 dB; **Channel Separation:** 20 dB from 50 Hz to 12 kHz; **Compliance:** 30 x 10^{-6} cms/dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.
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Replacement Stylus: R-60XE.

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Replacement Stylus: R-90XE.

ADC 220XE. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms/sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz ± 3 dB; **Channel Separation:** 20 dB from 50 Hz to 10 kHz; **Compliance:** 20 x 10^{-6} cms/dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.
Price: $25.95.
Replacement Stylus: R-20XE.

ADC 220X. Type: Induced Magnet; **Output:** 6 mV at 5.5 cms/sec. recorded velocity; **Tracking Force:** 1 to 2½ grams; **Frequency Response:** 10 Hz to 18 kHz ± 3 dB; **Channel Separation:** 20 dB from 50 Hz to 10 kHz; **Compliance:** 20 x 10^{-6} cms/dyne; **Spherical Stylus Tip Radius:** .0007" **Vertical Tracking Angle:** 15°.
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Tracking Force: ½ to 1¼ grams.
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Channel Separation: 30 dB from 50 Hz to 15 kH
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Type: Induced magnet with grain oriented diamond.
Output: 4 mV at 5.5 cms/sec. recorded velocity.
Tracking Force: ½ to 1¼ grams.
Frequency Response: 10 Hz to 24 kHz ± 2 dB.
Channel Separation: 30 dB from 50 Hz to 15 kHz.
Compliance: 50 x 10^{-6} cms/dyne.
IM Distortion: Less than ½%—400 & 4 kHz at 14.3 cms/sec. recorded velocity.
Vertical Tracking Angle: 15°.
Rec. Load Impedance: 47,000 ohms nominal.
Elliptical Stylus Tip Radii: Lateral radius .0007" x Contact radius .0003".
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states, its average power dissipation remains quite low. However, the greater the frequency at which it is switched between these states, the greater the proportion of its total time is spent traversing the higher dissipation portion of the load line, and the higher its average dissipation tends to rise.

It is true that except in very high speed switching applications where a device may spend a relatively small proportion of its total time in the OFF and ON states, the average device power dissipation is usually somewhat less than the instantaneous dissipation at the centre of the switching load line. Because of this it is quite common for saturated switching circuits to be designed so that the load line actually crosses the contour corresponding to the maximum rated power dissipation for the device concerned. Hence in figure 13.2(a), contour P3 might in practice correspond to the Pc(max) rating for the transistor.

In unsaturated mode switching circuits this is generally not done, mainly because of the higher average dissipation produced by the non-saturated ON state operating point. In such circuits the contour of Pc(max) for the device might typically lie just above the central portion of the switching load line, as suggested by the dashed contour in figure 13.2(b).

Although device dissipation does tend to rise with switching frequency in both saturated mode and unsaturated mode switching circuitry, it is usually not the device dissipation rating which limits operating frequency. Rather, this is limited by the maximum speed at which the device can perform the required switching reliably in the circuit concerned: the **speed of response.**

Typically a bipolar transistor switching circuit responds to input drive changes in a manner illustrated in figure 13.3. Upon application of input drive, a short time elapses before the output current commences to rise. This is followed by a further period in which the output current rises to its full ON state value. Similarly, upon removal of the input drive a significant time elapses before the output current commences to fall, followed by a further period in which it falls to the OFF state value.

The short time required before the output current begins to rise after application of input drive is normally called the **delay time,** symbolised Td. For convenience of measurement this is defined as the time period between the application of drive and the point where the output current has risen to 10% of its ON state value.

The basic physical reason for the delay time is that before the device can commence conduction, charge must be supplied to the emitter junction depletion layer to reduce its width to that corresponding to the onset of "turn-on." In other words the initial flow of input drive current is effectively used to charge the emitter depletion capacitance, and does not result in any change in collector current.

The amount of charge required for this purpose depends upon both the area of the emitter junction of the device concerned, and also the conditions prevailing at the emitter junction in the OFF state. The larger the area of the emitter junction, the greater the charge required to alter the depletion layer width by a given amount, and the larger the delay time. Similarly if reverse bias —Vbo is applied to the device in the OFF state, a greater change in depletion layer width is involved in preparing the junction for conduction than if zero bias is present in the OFF state, and the increased charge required accordingly tends to increase the delay time.

Hence from the point of view of minimising delay time, it is generally desirable to use a device with a small emitter junction area, and one which preferably does not require the application of reverse bias in the OFF state.

Following the delay time, the remainder of the turn-on time of the device consists of the time taken for the collector current to substantially complete its rise to the ON state value. This is the **rise time,** symbolised Tr. Conventionally the rise time is defined as the time taken for the collector current to increase from 10% to 90% of its ON state value.

The physical explanation for the rise time is that in order to increase the conduction of a bipolar transistor from the "just conducting" condition to that of full conduction, it is necessary to supply the device not only with the increased base drive current appropriate to the higher conduction state, but also with a further "lump sum" charge which is required to effect the appropriate change in internal conditions. Portion of the initial base current flow

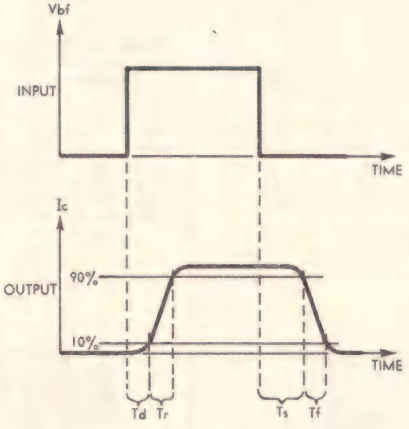

Figure 13.3

is used in supplying this "setting up" charge, so that until the device has obtained the charge and adapted to the new conditions, the full base current is not effective.

Basically there are three distinct components of charge which must be supplied to the device in this setting-up period. One component is the charge which must be supplied to the emitter junction depletion layer in order to narrow it to correspond to heavy conduction. In other words, the additional charge required by the emitter depletion capacitance.

A second component of charge is that required in order to set up the concentration gradient of injected carriers in the base region, necessary to produce a minority carrier base diffusion current equal to the full ON state collector current.

And the third component of charge is that which must be supplied to the collector junction depletion layer to reduce its width to correspond to the lower value of collector voltage present in the ON state. In other words, the charge required by the collector depletion capacitance.

All three components of the setting-up charge are determined partly by the internal geometry of the device, and partly by such circuit conditions as the supply voltage and the ON state collector current. Broadly speaking, the time required to supply each of the three components can be reduced for a given device by "overdriving," or considerably increasing the input drive current above that necessary to establish the ON state collector current. This may be done either on a "static" basis by increasing Vbf or reducing Rb, or on a "transient" basis, by arranging that an additional drive current is fed to the device only during turn-on.

The use of "static" overdriving naturally implies saturated mode switching, for it is only in this mode that overdriving does not essentially alter the ON state collector current. However, even in saturated switching circuits the use of static overdrive is not generally desirable, it causes a significant increase in the charge-storage effects to be discussed in a moment. Thus the most desirable way to reduce the rise time of a particular device is to use "transient" overdriving. One simple technique which achieves this end will be described briefly later in this chapter.

The significant time which elapses at turn-off before the collector current of the device commences to fall after the removal of input drive is called the **storage time,** symbolised Ts. This is defined by convention as the time period between the removal of drive and the point where the output current has fallen to 90% of its ON state value.

Basically, storage time is almost wholly associated with the previously mentioned charge storage effects produced when a bipolar device is driven into saturation. When a device is saturated, excess carriers are accumulated within the semiconductor lattice — carriers over and above those immediately involved in the conduction mechanisms. These excess carriers effectively constitute an inbuilt carrier "reserve" which allows the device to provide its own forward bias if external drive is removed. Hence upon removal of external forward bias the device continues conducting heavily until the stored carriers are exhausted.

With most bipolar devices, almost all of the excess carriers stored in saturation are located within the base region, being injected into this region from both the emitter and the collector. It should be fairly apparent that those injected from the emitter are basically excess carriers encouraged to take part in the normal emitter injection mechanism, as a result of the increased forward bias on the emitter junction. But the explanation for the additional injection of carriers from the collector may not be evident.

The clue to this behaviour is that, in the saturation situation, the collector-base junction of the device is effectively forward biased. In fact, as the reader may perhaps recall from chapter 10, the phenomenon of saturation occurs simply because the normal "collecting" action of the collector-base junction

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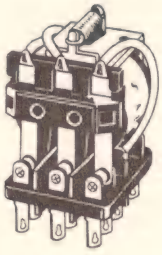

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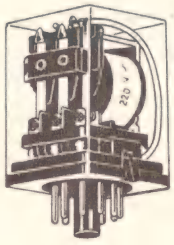

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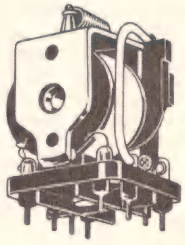

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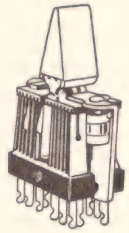

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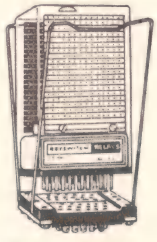

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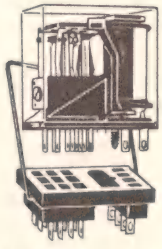

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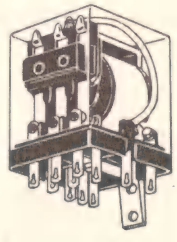

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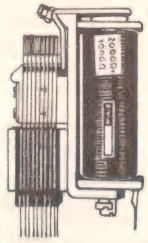

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breaks down if the collector voltage is allowed to fall to the point where this junction is no longer reverse biased.

In a situation such as that applying for our saturated switching transistor, where the device is passing a heavy current in saturation, carriers are obviously still crossing the collector junction in large numbers despite the breakdown in its minority carrier "collection" action. In fact the collector current in this type of situation consists of carriers moving across the junction in both directions as diffusion currents, encouraged by the forward bias conditions.

It is the component of saturated collector current comprising carriers moving from collector to base which provides the second source of carriers contributing to the excess accumulation in the base region. Hence it is basically these carriers, together with those excess carriers injected from the emitter, which provide the internal carrier "reserve" responsible for the continuation of device conduction during the storage time.

Like rise time, storage time is determined partly by the internal geometry of the device, and partly by the external circuit constants. An important factor within the device itself is the gain factor beta, to which storage time tends to be directly proportional. This follows because the higher the gain, the lower the effective base current required to sustain a given collector current, and hence the longer the period during which collector current can be maintained after removal of external bias by the accumulated carrier "reserve."

The external circuit factors influencing storage time are mainly the ON state forward bias current, which directly controls the amount of stored carrier charge accumulated within the device, and the OFF state bias circuit constants, which can assist turn-off by removal of stored carriers following the removal of forward bias.

For minimum storage time the ON state forward bias should be kept sufficiently low to ensure negligible accumulation of excess carriers within the device. In other words it should be prevented from saturating, as noted earlier. This explains the attraction of unsaturated mode operation at very high operating speeds. However, where saturated switching must be used, the base overdrive should fairly obviously be kept to the minimum level compatible with the requirements of expression (13.1), to prevent excessive storage time.

For a given device and ON state forward bias, the storage time is influenced by the effective constants of the bias circuit during the OFF state. A low impedance between base and emitter can reduce storage time, by providing a discharge path for the accumulated base charge. This effect is enhanced if a reverse bias —Vbo is used, as the accumulated carriers are then effectively "pulled" out of the base immediately forward bias is removed.

Following the storage time, the remainder of the time involved in transistor turn-off is that taken by the device in actually turning off. This is the **fall time**, symbolised Tf, and con- for the output current to fall from 90 % to 10 % of its ON state value.

The mechanisms responsible for the fall time are basically the converse of those responsible for the rise time. In this case, charge must be removed from the emitter and collector depletion layers, and also the minority carrier concentration in the base responsible for base diffusion must be dissipated.

Again, these mechanisms are influenced both by internal device geometry and by external circuit conditions. For minimum fall time the device used should possess small junctions having low values of depletion layer capacitance, and should ideally be forcibly turned off by means of a reverse bias —Vbo.

From the foregoing it may be seen that external circuit constants can play a significant part in determining a switching transistor's speed of response. Further illustration of this is provided by the diagrams of figure 13.4, which show some of the more common configurations used in practical switching circuits.

The circuit of 13.4(a) illustrates a technique often used to increase the operating speed of a simple saturated mode switch. The technique simply involves the connection of a capacitor Cb across the series base resistor Rb. The capacitor is often called a "charge-neutralising" or **commutating capacitor.**

The function of the capacitor is to lower the transient impedance of the bias source seen by the transistor. Thus at the onset of switch-on the capacitor effectively provides the device with a short pulse of overdrive which allows the emitter and collector junction depletion layer capacitance to charge up rapidly, and also allows the rapid setting-up of the minority carrier concentration gradient in the base. Hence both delay time and rise time tend to be significantly reduced.

Similarly at the onset of switch-off the charge acquired by the capacitor during the ON state tends to apply a transient reverse bias to the device, providing a means whereby the charge stored in the base region is rapidly drawn out. Thus storage time and fall time also tend to be improved, the former quite dramatically.

To achieve significantly higher switching speeds than those afforded by this technique, it is generally necessary to prevent the transistor from entering saturation. In other words, to adopt the unsaturated switching mode in preference to the saturated mode. Possibly the simplest way in which this may be achieved is illustrated in the circuit of figure 13.4 (b).

As may be seen the circuit consists basically of the elementary switch of figure 13.1, to which has been added two diodes. One diode is a silicon diode connected in series with the base electrode, while the other is a germanium type connected between the junction of Rb and the first diode, and the transistor collector. The configuration was first described by R. H. Baker in an MIT Lincoln Lab Report of 1956, and is often called the "Baker clamp."

The action of the diodes is to fix automatically the ON state operating point of the transistor just short of saturation. This action takes place as follows: As the transistor collector current rises, its collector voltage naturally falls due to the voltage drop across Rc. At the same time, the combined volt-

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age drop of the silicon diode and the base-emitter junction of the transistor rises, as the base current increases.

The effect of these two voltage changes is to cause the germanium diode to become forward biased just before the collector voltage falls to the point corresponding to saturation. The diode thereupon conducts and effectively shunts all further increases in input current away from the base, and into the collector. This not only prevents the base current from reaching a value corresponding to saturation, but also provides additional current to the collector, to defer the onset of saturation.

By preventing the transistor from entering saturation, this circuit considerably improves the speed of response of the device itself. However, bias design tends to be somewhat more complex than with the simple saturated switch, as it is necessary to ensure that the diodes perform their function reliably for all possible parameter variations in both the transistor and the diodes. There is also the problem that the speed of response of the circuit now becomes highly dependent upon the response of the germanium diode, which must be a special high-speed type.

Probably the most satisfactory type of unsaturated mode switching circuit is the so-called **current mode configuration.** This is illustrated in basic form in figure 13.4(c).

It may be seen that the configuration differs from that of the simple switching circuit, in that the emitter of the transistor is now taken to a source of supply —Vee via a resistor Re. A diode D is also connected between emitter and ground.

The emitter voltage —Vee and resistor Re are deliberately chosen such that they provide an effectively constant source of current, whose magnitude is less than the value of emitter current corresponding to transistor saturation. This current flows into the transistor emitter when the base of the device is taken to a source of bias which is slightly positive with respect to earth.

In so flowing through the transistor, the current rigidly holds the ON state operating point of the device at a point outside the saturation region. Variations in the forward bias applied to the base, and in the beta of the device have virtually no effect on the operating point because of the controlling effect of the constant emitter current.

The purpose of the diode D is to act as an alternative path for the current from Vee—so that the transistor can be turned off! Changeover of the current from the transistor to the diode is simply arranged by taking the base of the device to a reverse bias sources which is slightly negative with respect to ground. This forces the transistor to attempt to reproduce a voltage at its emitter which is more negative than the potential at this point if the full current through Re were flowing through the diode; accordingly the transistor cuts off, and the current switches into the diode.

It may be appreciated from the foregoing brief explanation that current mode switching offers excellent DC operating point stability, is relatively easy to design, and is very insensitive to transistor parameter variations, while at the same time possessing the ability to operate at very high speeds which is characteristic of the unsaturated switching mode. For this reason current mode switching circuits are finding increasing use in high speed switching applications.

While the basic current mode configuration shown in figure 13.4(c) is quite practical, it is less commonly used in practice than the slightly modified configuration illustrated in figure 13.4(d). The operation of this circuit is virtually identical with that of the simpler circuit; the main difference is that the function of the diode D is now performed by a second transistor.

The base of the second transistor is supplied by a temperature-compensated bias voltage Vd, developed across a series diode combination. This obviates the need to apply a reverse bias to the gate of the switching transistor in the OFF state. Simply taking the base of the first transistor to ground is now sufficient to cause the current from Re to switch to the second transistor, because of the latter's forward bias Vd.

To switch the first transistor to the ON state, it is again simply necessary to apply a small forward bias to the base. In this case the bias is only required to take the base slightly more positive than the voltage Vd present at the base of the second transistor. The current from Re then switches rapidly into the first transistor, again defining its operation very stably at a point outside saturation.

One of the advantages of this modified current mode configuration is that the second transistor may itself be used to perform switching, simply by inserting a second load Rc' in series with its collector as suggested by the dashed symbol in the diagram. Naturally enough, because this transistor is ON when the other is OFF, and vice-versa. it will act as a converse-acting switch. However this can be an advantage in logical switching circuits, where the logical converse or "complement" of a switching function is often required.

Having examined the basic aspects of bipolar transistor switching, let us now turn to look briefly at a small number of representative applications in which this mode of operation is involved.

One important application of this type is in power inverters and converters, used to produce high-voltage AC and DC respectively from low voltage DC sources. Here the bipolar transistor switches are used basically as automatic "choppers," to effectively convert the DC input into square-waveform AC capable of being fed to a step-up transformer. In this respect they perform a function very similar to the electromagnetic "vibrator" used previously in these applications.

The basic circuit for a typical DC-DC converter using two power NPN transistors is shown in figure 13.5 (a). It may be recognised as a push-pull blocking oscillator circuit in which the two transistors alternately drive each other into saturation and cutoff. Reliable starting is ensured by means of a small fixed bias applied to both bases via the divider formed by resistors Ra and Rb. The alternate switching between states is triggered by a breakdown in normal transformer action between the common collector and individual base windings due to the transformer core entering magnetic saturation, at the appropriate time after the previous switch-over.

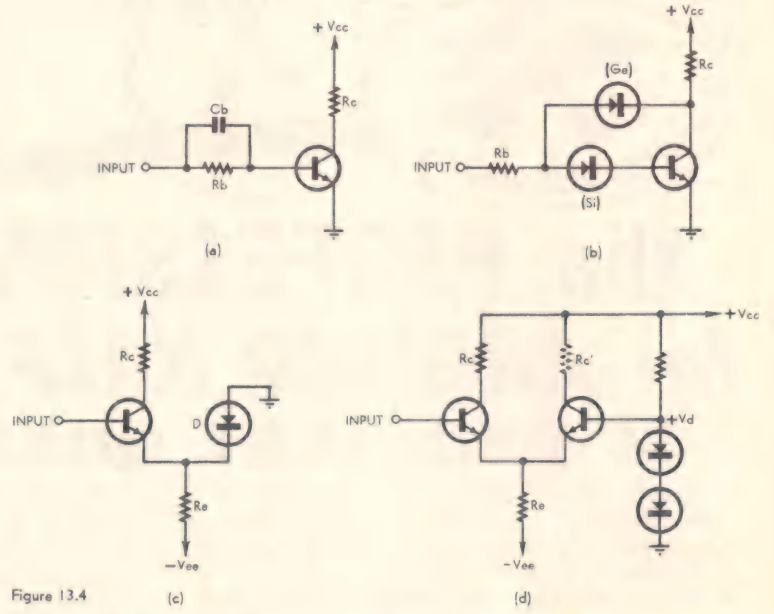
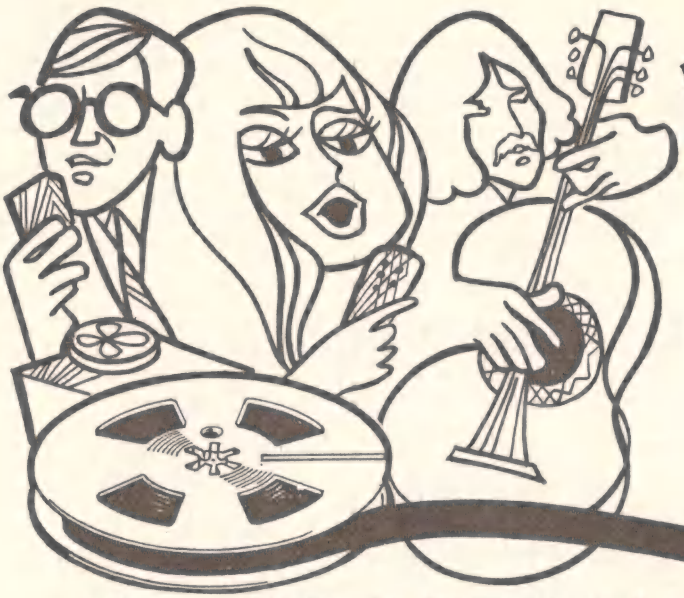


Figure 13.4

The reversing magnetic flux in the transformer core produced by the transistors induces an appropriate AC voltage in the secondary winding, which in the case of an inverter feeds directly into the load. In a converter a rectifier and filter system are used to produce a high voltage DC output instead, as shown.

A bipolar transistor application not unrelated to the foregoing is that wherein the devices are used for modulation and demodulation in chopper amplifiers. As the reader may be aware, chopper amplifiers are basically AC coupled amplifiers which are fitted with an input modulator and output demodulator system which enables them to respond not only to the "AC" components of the input signal, but also to the "DC" component.

The basic configuration of a chopper amplifier using bipolar transistors for modulation and demodulation is shown in figure 13.5(b). Here both transistors are operated as saturated switches which are switched synchronously on



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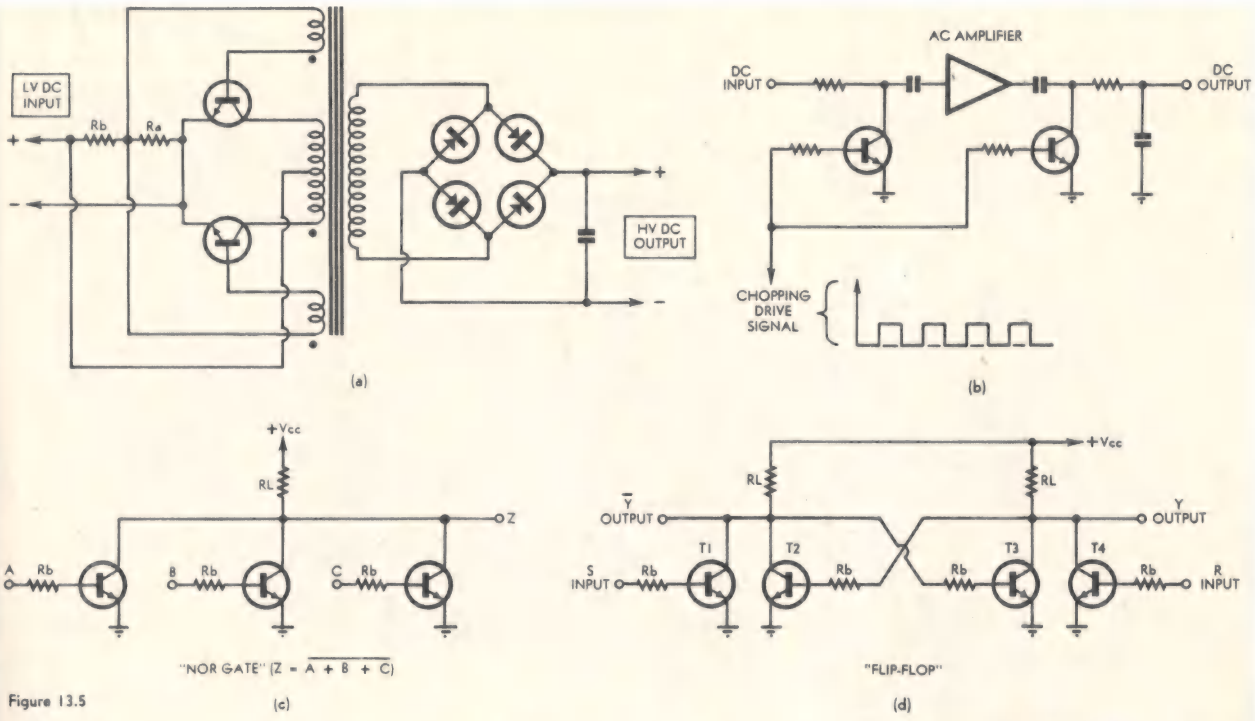

Figure 13.5

and off by a square-wave "chopping" drive signal. The first transistor effectively chops the input signal into an AC signal at the chopping frequency, of corresponding amplitude. This signal is then amplified by the amplifier in the normal way, so that a large AC square-wave signal whose amplitude is proportional to the original DC input signal appears at the amplifier output.

This signal is demodulated to produce a corresponding DC output signal, by the action of the second transistor switch. By effectively shorting the "load" end of the amplifier coupling capacitor to ground in synchronism with the action of the first transistor, this transistor forces the output coupling capacitor to acquire a charge which effectively restores the DC level of the square-wave signal. It is then only necessary to integrate the signal by means of a low-pass R-C filter, to remove the chopping frequency component and leave the original signal.

Although bipolar transistors find wide application in such switching applications as inverters, converters and chopper amplifiers, and also in pulse-width switching mode amplifiers and voltage regulators, perhaps the most rapidly growing of their switching applications is that of digital circuitry. Here transistor switches perform a wide variety of logical functions, ranging from simple logic gating to complex functions performed by elaborate configurations of transistor gates and transistor "flip-flop" storage elements.

Just two of the many transistor circuit configurations found frequently in digital applications are shown in the diagrams of figure 13.5(c) and (d).

In (c) is shown a simple logic gate consisting of three transistor switches sharing a common load resistor Rc. The idea is simply that the "output" voltage at point Z will only be at its "high" level if all three transistors are off — in other words, if none of the three input terminals A, B and C have forward bias applied. The application of forward bias to any one, two or all three of the inputs will cause the voltage at Z to fall to its "low" level, due to the conduction of one or more of the transistors.

This fixed relationship between the input and output conditions of the circuit allow it to be used to perform a variety of logical gating functions. For example if the inputs A, B and C are connected to three digital signal sources whose output is time-dependent, the appearance of a "high" output at point Z necessarily implies that at the instant concerned, none of the three sources are providing a "high" output. In this case the gate would be said to perform the logical "NOR" function.

The configuration shown in figure 13.5(d) is that of a simple "flip-flop" storage element. Here the idea is that because of the cross-coupling between the two central transistor switches T2 and T3, only one can be ON at the one time; the other must necessarily be OFF. Hence because the circuit is quite symmetrical, the circuit has two stable states — one with one transistor conducting, the other with the second transistor conducting.

The circuit may be forced to adopt either of these states at will simply by applying forward bias to either of the two additional transistors T1 and T4 connected in parallel with the cross-coupled pair. Hence forward bias applied to the "R" input causes the shunt transistor T4 on that side of the circuit to short the collector of its companion T3 to ground, removing the forward bias from the alternate device T2. This causes the latter device to cut off, so that forward bias is provided to maintain T3 in conduction after the removal of the external signal. The application of forward bias briefly to the "S" input produces the opposite effect, T2 being left in conduction with T3 cut off.

Because it possesses the ability to operate in one of two stable states, a flip-flop element such as that shown is eminently suitable to act as a storage medium for information in the form of binary numbers. Its state may be monitored at any time simply by examination of the voltage levels at the "output" terminals attached to the collectors on each side.

And with these brief comments we must bring the present chapter to a close. The survey of bipolar transistor switching operation and applications which has been given is necessarily very cursory and incomplete; to do full justice to this topic would require many weighty volumes. However, it is hoped that if nothing else the basic material presented will have given the reader an insight into the concepts involved, and may perhaps provide motivation for further reading in sources such as those listed below.

SUGGESTED FURTHER READING

MILLMAN, J., and TAUB, H., **Pulse, Digital and Switching Waveforms,** 1965. McGraw-Hill Book Company, Inc., New York.

PHILLIPS, A. B., **Transistor Engineering,** 1962. McGraw-Hill Book Company, Inc., New York.

ROEHR, W. D. (Ed.), **Switching Transistor Handbook,** 4th Printing, 1967. Semiconductor Products Division, Motorola Inc., Phoenix, Arizona.

ROWE, J., **An Introduction to Digital Electronics,** 1967. Sungravure Pty. Ltd., Sydney.

WALSTON, J. A., and MILLER, J. R. (Ed.s), **Transistor Circuit Design,** 1963. McGraw-Hill Book Company, Inc., New York.

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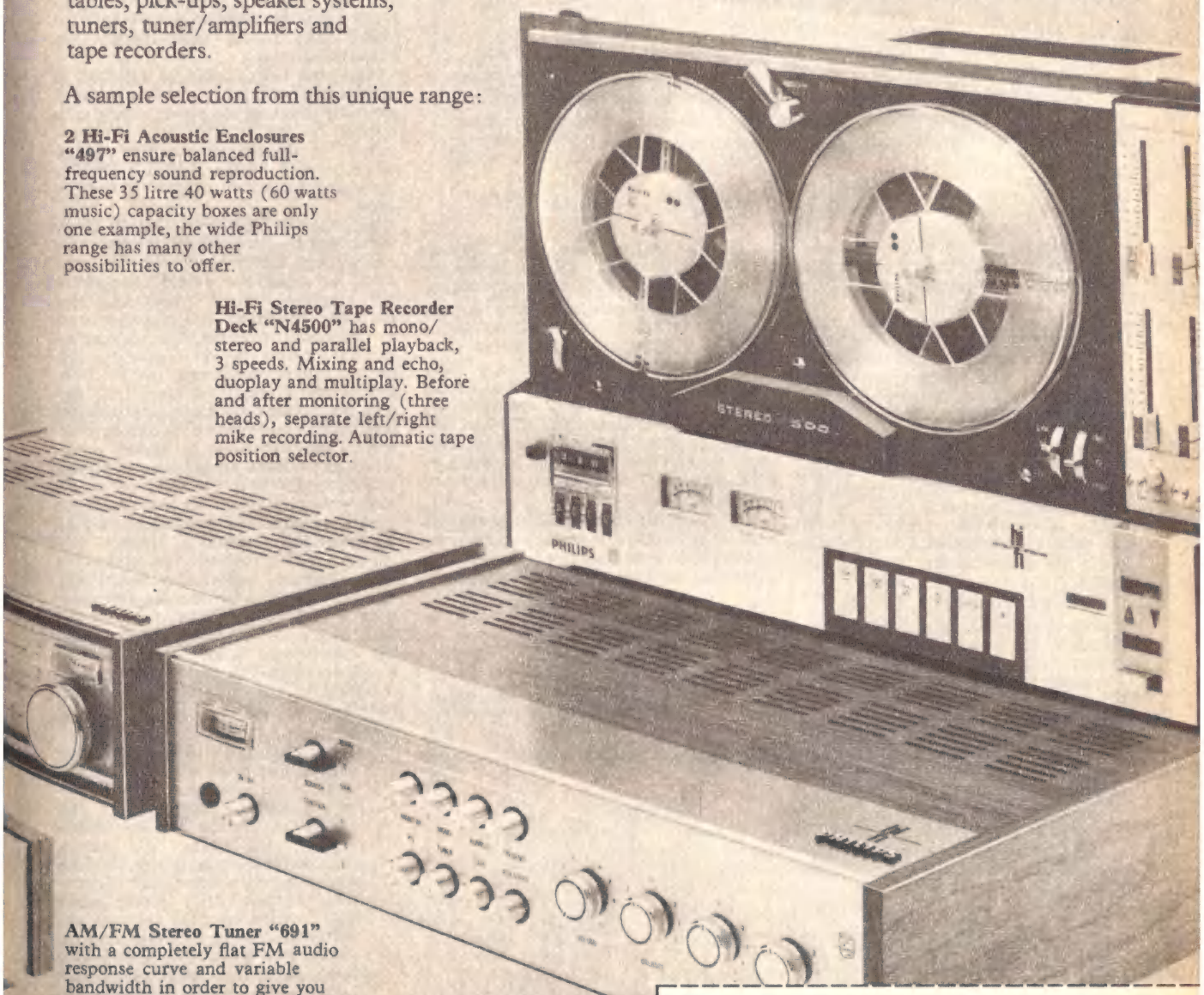

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FORUM

Control tones — an amplifier problem?

The frequent references to control tones on the power mains, and their penetration into audio equipment, have prompted a letter from the Radio Branch in Brisbane of the Postmaster-General's Department. It is quite a lengthy letter but one that is well worth reproducing in full.

Conducted by the Editor

I would judge, from conversations I have had, that the letter fairly closely represents the experience and attitude of the Radio Branch in New South Wales; I cannot speak for other States. I also gather that the Radio Branches get involved in the question mainly because people who lay complaints about interference allow for no fine distinctions about audio frequencies and radio frequencies. If a TV set, a radio set or a stereogram emits a noise that can be referred to as "interference," then a radio inspector is summoned to do something about it.

The letter follows, reproduced for the sake of convenience, in standard body type and without quote marks:

The Editor,
Electronics Australia.

Dear Sir, — I refer to the letter signed W.F. in your December issue concerning load shedding control signal interference.

Some of the statements contained in W.F.'s letter are misleading and to avoid further confusion, I request the opportunity to clarify some of the misconceptions currently being circulated on this subject.

Whatever the origin of W.F.'s confusion, it is certain that no P.M.G. or B.C.C. official could be responsible for some of the alleged "advice" contained in his letter. For example:

(i) "Someone suggested that I drive 6ft fencing spikes down into the ground, couple them together and take this 'silent' earth to the mains outlet earth."
This suggestion is not only absurd, but quite illegal. No power authority would countenance such a situation for obvious reasons. Mains earth systems must comply with standards as laid down in S.A.A. wiring rules. Certainly no Queensland power authority would approve an earthing arrangement of this kind.
(ii) "The B.C.C. man measured the signal voltage at my place at 5.5V. They said it should not be more than 3V. B.C.C. and P.M.G. men both said it was objectionable."
These alleged comments are, to say the least, remarkable considering that a control tone signal voltage between 5V and 6.5V would be considered normal rather than excessive.

Other statements attributed to the P.M.G. technical officer investigating W.F.'s problem are similarly in error or taken out of context.

Unfortunately, the filter used during tests at W.F.'s premises was defective due to a component failure. When correctly designed and adjusted, this filter will provide 20dB to 30dB isolation of the offending tone signal, depending upon circuit conditions.

It should be emphasised that the use of a mains filter is merely one means of correcting a condition arising from spurious response within the audio amplifier section of the affected apparatus. From an economic viewpoint, it may in many cases be preferable to employ a mains filter rather than modify the amplifier circuitry.

The filter used should be designed to protect the affected apparatus without seriously shunting the power mains with respect to the control tone voltage; hence the double section filter design recommended by the P.M.G.'s Department and illustrated in your December issue.

Experience has shown that in many instances, the problem of control tone interference can be satisfactorily overcome by relatively simple changes in AF amplifier circuit layout and, appropriate attention by manufacturers to this need is overdue. The serviceman encounters difficulty in correcting this built-in condition because the brief intervals during which control tone signals are applied to the mains presents him with considerable difficulty in evaluating any corrective action he might take. In addition, of course, amplifiers prone to respond to control tone signals may also be subject to impulse noise effects — pops and crackle introduced by power mains switching action.

For the information of servicemen and designers of audio amplifiers, records taken from numerous test cases over a period of several years reveal that the proportion of amplifiers suffering interference from tone signals is small and that the major factors contributing to the problem of amplifier response to control tones are as follows:

(i) Unshielded 240V AC wiring adjacent to low level AF amplifier circuitry, e.g. volume control — power switch combinations. Inadequate isolation and/or shielding of PU leads, PU heads, recording heads etc. from AC fields associated with items such as turntable or tape drive motor windings, mains wiring and so on. Effective isolation screening and earthing of motor frame and low-level audio frequency wiring such as connecting cables, PU leads etc. is essential to minimise stray coupling effects.

(ii) Induction into long leads of remotely located speakers where voice coil type feedback is employed. Test with a local speaker after removing the remote system will establish the position here.

(iii) Induction from the magnetic field of power transformers, filter chokes etc. Care in circuit layout and/or shielding of transformer windings satisfactorily contains this source of trouble. The use of an electrostatic screen between

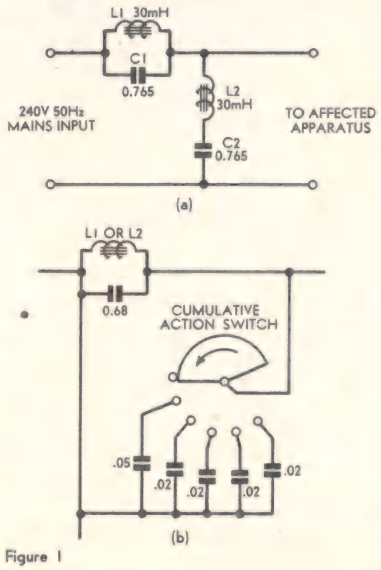

Figure 1

Figure 1a, at top, illustrates a two-section mains filter suggested to combat 1050Hz control tones. The series and shunt arms must be resonated to 1050Hz, involving the use of an accurately calibrated signal source, a CRO and means to verify the resonating capacitance, as in figure 1b below.

power transformer primary and secondary windings may also be of value.

(iv) Unshielded or unbalanced vacuum tube heater leads adjacent to low level AF circuitry. Twisted pair type heater wiring with heater supply balanced to earth (chassis) assists in minimising this source of induction.

(v) Heater-cathode leakage in vacuum tube amplifiers.

(vi) Earth loop circuits within the amplifiers system. Again care in circuit layout minimises this condition.

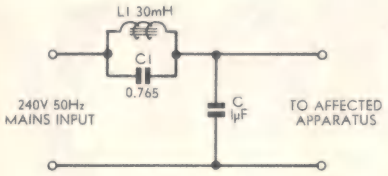

Figure 2

Figure 2: A somewhat simpler type of 1050Hz filter involving a resonant series element L1, C1 and a 1uF shunt capacitor.

(vii) Inadequate HT filtering due to faulty electrolytics, and inadequate interstage decoupling.

When first considered, the degree of interference caused by control tone signals of 5V superimposed on 240V 50Hz mains supply appears to be disproportionately high. However, the interference from 5V of mains-borne sinewave control tone signals in amplifiers reasonably free from 50Hz and 100Hz effects can only be due to the relative response of amplifier and speaker, to the relative effectiveness of stray coupling at these frequencies respectively as well as the response of the human ear. Investigation has shown that excessive level of the tone voltage is not a major factor.

Control tone modulation of broadcast signals due to "external rectifier" effects is infrequently encountered and should be dealt with in the same manner as the more familiar conditions of mains frequency hum modulation. This form of interference is readily identified as it normally affects one signal only and is not evident when the receiver is tuned off-station. The P.M.G.'s Department, Radio Branch, is familiar with this problem and can advise accordingly.

A radio-earth sometimes assists in minimising control tone interference. The radio-earth consists of heavy insulated wire connected between the radio-earth terminal and a radio-earth electrode such as a length of 1in galvanised water pipe driven 4ft into earth. The "earth" lead should of course be kept as short as possible. The water mains system may be used as radio-earth electrode provided the water pipe enters the ground at a point reasonably close to the radio earth lead connection.

The earth lead must be of insulated wire and must not in any circumstances be connected to the electrical mains earth system.

A word about the filter — See figure 1a.

L1 carries the full load current of 1-2 amps. No. 18B&S enamelled copper wire was used for the windings. The core iron must have sufficient cross-sectional area together with air gap to prevent magnetic saturation at two amps. A high-grade core iron of fine laminations was used to minimise iron losses at 1050Hz and so maintain a high Q-factor. 10-24-30 Grade 56 unisil grain-oriented iron was used employing 12 thou. ins. laminations in shell type configuration.

The current passed by L2 is less than 60mA and so the core area required is much less than for L1. However, the core material must again be of high-grade iron to minimise iron losses and so maintain a high Q-factor if adequate rejection of the control signal is to be obtained.

The inductance of L2 could well be increased in value and C2 reduced proportionally. L2 of 60mH and C2 at 0.3825uF should be quite satisfactory. The value of 30mH for L1 was deliberately chosen to keep the reactive voltage drop at 50Hz to a minimum.

The filter used by the P.M.G.'s Department employs similar components

Deafness and stereo

While checking copy for this issue, we spotted an item which had been prepared for inclusion in the "Answers To Correspondents" section. It raised a question which may interest quite a few readers, some of whom may be able to comment on our answer, as a result of rather unhappy experience.

EFFECT OF DEAFNESS: Could you please answer a question for me? Is it possible for a person who is deaf in one ear to appreciate the effect of stereo sound, in the same way as a person who has normal hearing? (A.K., Clontarf Beach, Qld.)

● We have not studied the matter in detail but can answer in a general way. The loss of hearing from one ear does restrict the ability of the person concerned to perceive the direction from which sound is coming. At the same time it is necessary to ask whether the faulty ear is completely non-functional or able to make some contribution to the total sensation. There is also room for speculation as to whether the person concerned can develop some compensating ability; whether this is related mainly to familiar environments or whether it can apply for sound from sources such as loudspeakers, which give no visual clue as to their activity. Our conviction would be that a person deaf in one ear could not appreciate the full subtleties of a stereo presentation. This does not necessarily mean that such a person could not tell the difference between a stereo and mono reproduction, because of second-order reaction to the separate sound sources. This looks like a good subject for discussion. What do readers find who have to live with this limitation?

How to put a battery in its place

Silver is the Eveready low-priced battery for torches and transistors used occasionally.

Red is the Eveready medium-priced battery for transistors, torches and appliances used frequently.

Gold is Eveready's new alkaline battery. Gives up to—10 times more service in toys; 7 times in industrial torch use; 6 times in cameras; 5 in tape recorders and record players; 4 times in flash guns and 3-4 times in transistors.

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in both rejector and acceptor circuits with very satisfactory results.

For determining the value of fixed "C" required to tune L1 and L2 to resonance, a decade capacitor box or the arrangement shown in figure 1b is useful. An LC bridge, cathode-ray oscilloscope and signal generator with low inherent distortion are also essential for accurate adjustment.

Where the degree of interference encountered is small, a simple filter consisting of a single rejector circuit, L1 C1 in the active supply lead in conjunction with a capacitor of about 1uF shunting the mains on the appliance side of the filter should provide sufficient attenuation of the interfering tone signal — See figure 2.

Perhaps a word on the purpose of control tone signals may help to induce a more constructive reaction to the annoyance felt when interference from this source is encountered.

Power house installations are necessarily designed to have the capacity to provide a widely fluctuating load demand and the cost of these installations is, therefore, in accordance with the peak load demand.

Thus the charges applied to the bulk supply of electricity are estimated approximately according to the peak load requirement. This peak load demand which occurs between the hours of 6 a.m. and 9 a.m. and again 4.30 p.m.-8 p.m. daily, being accentuated during winter months, can be as much as twice the annual daily average requirement.

Figures 3a and 3b clearly show the fluctuation in load imposed by uncontrolled hot water storage and the improved situation under controlled conditions.

Figure 3c illustrates the reduced irregularity in the daily total load demand with the introduction of load shedding during peak load periods. The peak/average load ratio will be further reduced as the load shedding facility is extended to all sections within a given area.

Thus any measure which reduces the peak demand by a system of load shedding during peak load periods, such as sequence switching of hot water systems and other non-essentials will provide considerable benefit to the consumer by way of lower electricity charges.

If manufacturers of audio amplifiers can make the necessary adjustment in circuit design to minimise spurious response. I feel certain that we can live with this most economic means of controlling peak electricity supply requirement which primarily is designed to lower the cost of electricity production and ultimately to benefit the consumer.

G. A. Kirkegard,
Radio Branch,
P.M.G Dept., Brisbane.

COMMENT: First, I would like to express appreciation to Mr Kirkegard for a thoughtful and well expressed letter. I do not want to comment at length but I think some comment is warranted. To avoid the need for lengthy prose, it may be best to use paragraph headings and an abbreviated style.

ECONOMY, ATTITUDE: The economies involved are obvious but there has been complaint that the attidude of some supply authorities has been far too off-handed: "We're solving our problems; you solve yours!" There is certainly little evidence to date of prior research into equipment problems, prior warning to consumers, or information about precautions and corrective measures that might be necessary.

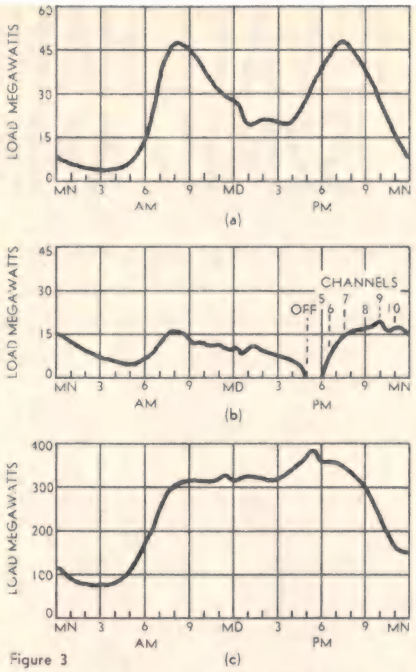


Figure 3

Figure 3a (top) shows a load curve for uncontrolled storage hot water systems. Figure 3b (centre) shows a controlled curve, with all systems off between 5p.m. and 6p.m. Figure 3c (bottom) is a typical total load curve reflecting the benefits of load shedding, with further control still required around 7.30p.m. in particular

AUDIO EQUIPMENT: There is a tendency to criticise equipment because it now does not reject control tones superimposed on the mains. The critics seem to overlook the fact that, for the most part. the equipment and relevant design practices preceded the introduction of the relatively high frequency control tones.

FEEDBACK CIRCUITS: For decades. amplifiers have used negative feedback to sense conditions in the load circuit, whether or not physical connection is made to the secondary winding. What is the equipment owner supposed to do if tones now superimposed on all the wiring in his neighbourhood induce a signal into his loudspeaker lines?

FILTERS: These may have an application in certain specialised situations but one cannot see them being bought or built in large numbers by private individuals. And remember that they cannot be inserted in the supply line to a whole house or even to a group of ostensibly general-purpose power outlets. One would be needed in the lead to each affected appliance.

EARTHING SYSTEMS: Mr Kirkegard is caustic in his remarks about the "silent" earth. It is granted that safe wiring practices must be observed but, later in his letter, Mr Kirkegard states that something other than a power-line "earth" may help on some occasions. This is in line with what I have already suggested, that "earth" conditions play a part in some problem situations.

ANOTHER SIDE: There is evidence to suggest that the trouble has abated since we mounted our campaign — this without any modifications to amplifiers, loudspeaker lines or earthing systems. This can only be explained (a) by more awareness by the authorities about how much voltage is being imposed on the line and (b) by the use of more injection points, thus avoiding control tone "hot spots."

IN SUMMARY: Designers of audio equipment may have to take greater care in future to isolate mains wiring from input circuits. However, the problem may never have assumed the proportions it has if authorities had paid more attention to precautions, to injection points and to voltage levels, when they were installing the systems. ■

1-WATT HANDSET FOR THE 52MHz AMATEUR BAND

Following the description of our Handset last month, we now consider the final construction and alignment details promised; we have also included the modification to permit the receiver section to tune from 52MHz to 54MHz continuously.

By Alan Nutt

Part Two

Our Handset, modified to provide a tunable receiver section, requires little change from the fixed frequency version, apart from the inclusion of some dial calibration.

Details of the telescopic aerial are shown in figure 1. The coaxial plug is a standard UHF type and is more robust than the cheaper Belling Lee variety, making it appropriate for this particular application.

For a permanent assembly, the nylon bushing should be cemented into the body of the co-axial plug before the threaded pin is passed through. It is preferable to tin the tip of the pin before inserting it into the plug as it then becomes a simple matter to flow solder down the centre hole of the plug contact and make a good joint. Solder quickly with a hot iron.

Most telescopic aerials have a tapped plug in the base of the lowest section. If modification is required, however, it is not difficult to make up a small brass plug with a tapped centre hole and solder it into the base of the whip as indicated.

We were able to obtain an aerial which, with the lower section removed, was exactly the right length for the frequency involved. Other aerials, longer if necessary, may be used although some calibration mark will have to be used to indicate when the correct extended length is reached.

For a frequency of 53.866MHz the length, corrected for an average cross-section of ¼in dia., is 53.25in. The required length for other frequencies may be calculated by the following formula which has been corrected for the same average cross-section:

$$\text{Length (ins.)} = \frac{2860}{\text{f(MHz)}}$$

Alignment is relatively straightforward and is simplified if an RF voltmeter is available. An ordinary multimeter may be used quite satisfactorily in conjunction with the crystal detector shown in figure 2. As only relative voltage measurements are required there is no need to provide an accurate calibration.

Before switching on, examine carefully the underside of the printed board for possible unwanted solder "blobs," dry or unsoldered connections. Call tone switch and squelch control should both be "off."

No receiver IF alignment is necessary, the ceramic filters taking care of these stages. The receiver oscillator should first be adjusted, followed by the RF front-end.

Plug in the edge connector. Connect the RF voltmeter or crystal probe across the HF crystal, X2. Screw out the slug in L10 as far as possible. Switch on the set and observe the voltmeter. A reading will indicate that the oscillator circuit is functioning, the actual voltage measurement being unimportant.

Slowly screw in the slug in L10, watching for a pronounced dip in the RF voltmeter. Leave the slug set at the point giving lowest RF voltage across the crystal.

Remove the probe and connect it between gate and ground of Tr10. Adjust the slug in L9 for a maximum meter reading. Remove the probe.

Adjustment of L6, 7 and 8 is best accomplished with the aid of a VHF signal generator, although many lower frequency generators can be pressed into service, using the second or even third harmonic of a lower frequency band. If no generator is available, the signal from a local amateur station may be used to peak all three slugs for maximum output in the earphone. It is not recommended that the transmitter oscillator be used as a signal source, the level being too high for satisfactory results.

Check that the call tone switch brings up the call tone in the earpiece and that both tone and receiver noise can be effectively muted by the rotation of the squelch control.

Before commencing the transmitter tuning, the printed board should be mounted by means of ¼in tapped brass spacers to the main panel, the proximity of which will affect the setting of the tuned circuits.

The transmitter may be adjusted initially by means of a GDO, setting each of the four tuned circuits in turn to roughly the correct operating fre-

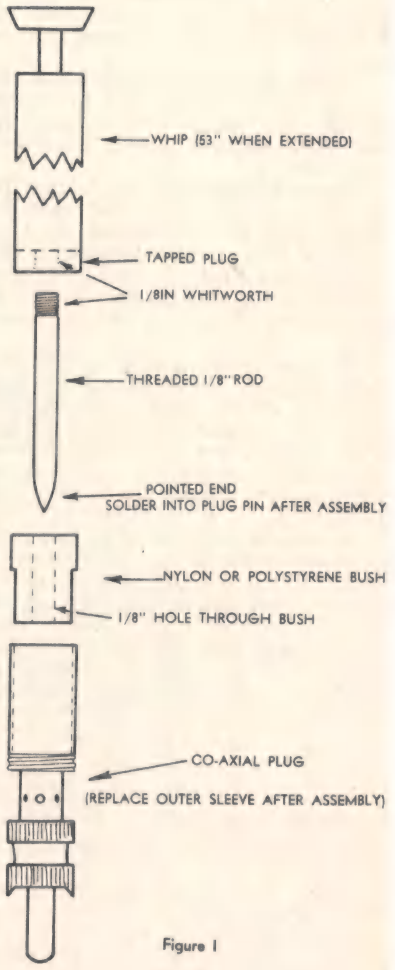


Figure 1

The assembly details for the antenna are illustrated above. Use a hot iron and solder quickly when assembling the threaded rod into the plug.

quency. Set the trimmer, C4, between PA emitter and ground to full capacitance and the output loading capacitor, C6, about one-third capacitance.

If a 50-ohm, low-level RF power meter is available, connect it temporarily to the aerial socket on the top panel. If no power meter is available, temporarily solder a 47-ohm, 1W resistor across the coaxial aerial socket, keeping the leads as short as possible.

Screw out the slug in L1 and connect the RF probe across crystal X1. Key the transmitter and adjust the slug as before for minimum RF voltage. Dis-

Figure 3

The only coil modification required is the addition of a few turns to L10 which becomes the receiver oscillator tuning inductance.

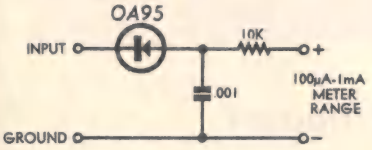


Figure 2

The above circuit may be used with a standard multimeter set to a low current range for transmitter and receiver oscillator adjustment.

connect the probe and, if no RF power meter is being used, reconnect it across the 47-ohm dummy load resistor at the aerial socket.

Key the transmitter again and adjust C1, C2, C3, and C5 for maximum indicated RF output. If a GDO has been used to roughly set up the tuning it should be possible to obtain an indication of output immediately on keying. If no indication can be obtained, each stage may be tuned individually, either by using the crystal probe across the input to the following stage or by using an absorption wavemeter, tuned to the operating frequency and coupled to the circuit in question.

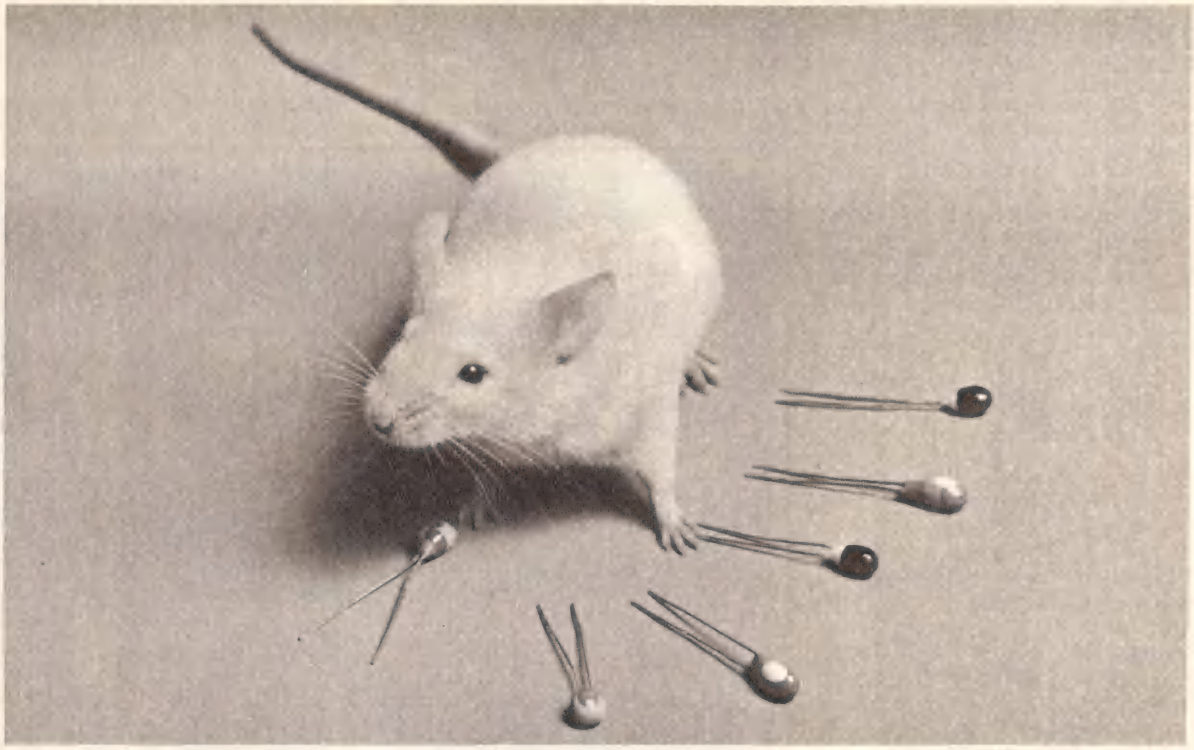
The best modulation quality or, to be more precise, the optimum modulation linearity is not necessarily co-incident with maximum transmitter output. A listening test on another receiver will readily confirm this and only by careful readjustment of C3, C4, C5 and C6 will it be possible to obtain good quality AND maximum output.

If, on monitoring, the transmitter is obviously overmodulated some adjustment may be made either, in the case of a carbon microphone, by adjustment of the resistive divider across the insert or, if a high level rocking armature type is used, by increasing slightly the value of the 56-ohm resistor in the emitter of Tr5.

When the tuning has been optimised, an RF power meter should indicate an output of approximately 1 watt. The crystal probe and voltmeter reading cannot be used to give a reliable indication of power level unless it can be compared against some known standard, or a commercial VTVM and RF probe have been used instead.

For net operation it is possible to pull both receiver and transmitter HF crystals on to frequency by careful readjustment of the slugs in L10 and L1 respectively. A shift of the receiver oscillator may be necessary to counteract the spread in the design centre frequency of filter, F1, as mentioned earlier.

We have chosen to use a simple, wrap-around case to house the trans-



Do you have a circuit for a 68μF/3V mouse?

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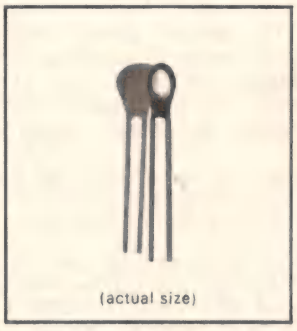

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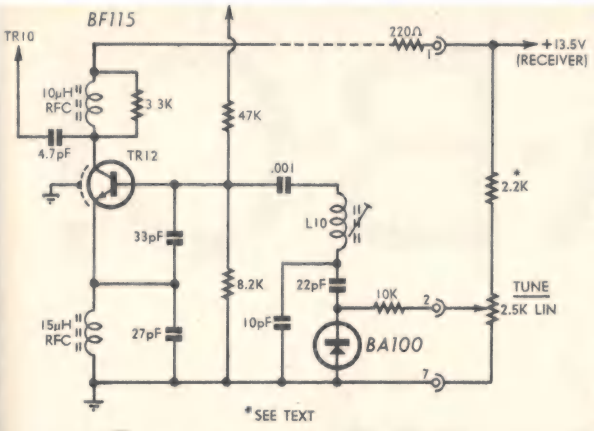


EA 52MHz HANDSET — RECEIVER VFO

The modifications for tunable operation are summarised in the text and should be read in conjunction with this diagram. We have used a standard silicon diode tuning element rather than one specifically designed for this type of service. Component spread may require adjustment of the 2.2K resistor in series with the tuning potentiometer.

across the 13.5V supply line. The value of this resistor may be adjusted as necessary to give the required 2MHz tuning range. Increasing the value will reduce the range and, conversely, decreasing it increases the range. The wiper contact connects to pin 2 on the board socket.

Reconnect the BA100 diode between its original junction point with the 2.2K resistor and the hole vacated by the earth link to the emitter of Tr14. From the same junction point connect the 22pF series capacitor to the hole vacated by the "hot" crystal pin and, at the same time, fit the 10K diode isolating resistor in the place originally occupied by the diode, terminating its far end on the copper strip to connector pin No. 2.

The 10pF shunt capacitor can be

(Continued on page 70)

ceiver. Here, again, individual preference will dictate the particular style, finish and so on. One final point to note concerns the mounting position of the cradle-cum-carrying handle which should be located directly above the centre of gravity for ease in carrying. The offset position chosen in our case proved very satisfactory and left adequate room for control knobs and sockets.

Dye-line prints of the metalwork drawings are available through our Information Service at a cost of 50c. If an alternative telephone handset to the one specified is used it may be necessary to modify the dimensions of the carrying handle to permit a neat fit in the cradle section.

As we intimated last month. the usefulness of the receiver may be extended by making it tunable over the entire 6-metre band and the following details are provided for those who may care to make this modification.

The changes centre mainly around the receiver HF oscillator which is rearranged to become what is basically a series tuned Colpitts circuit. Figure 4 shows the modifications and component values selected for coverage from 52MHz to 54MHz.

In order to accommodate the changes it will be necessary to delete the squelch and call tone facilities, space being somewhat at a premium.

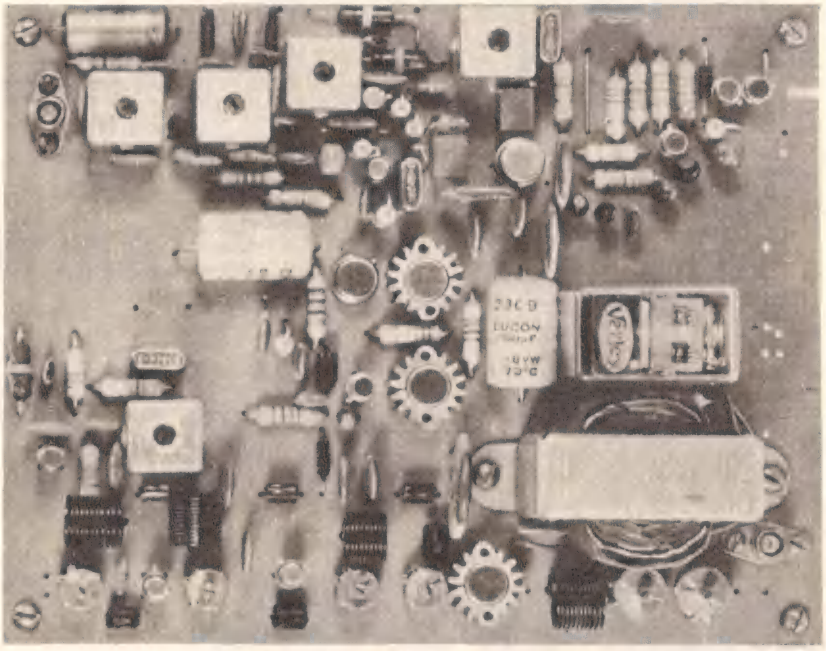
The tuning is accomplished by means of a reverse biased silicon diode which forms a small portion of the oscillator tuning "C." The junction capacitance of this diode is a function of the amount of reverse bias applied, supplied in this instance by a potentiometer connected across the supply line. This potentiometer becomes, in effect, the tuning control.

By selecting a suitable value of capacitor in series with the diode, the requisite amount of "bandspread" can be easily achieved. Bandsetting is accomplished by adjustment of the slug in L10 which becomes the main tuning inductance.

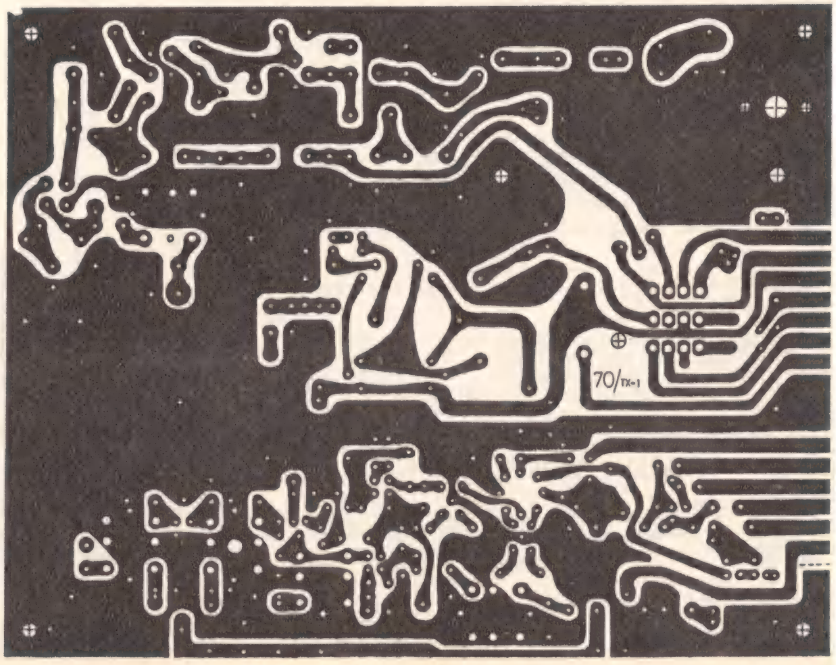
The modifications may be summarised as follows:

Remove the squelch potentiometer, transistors Tr13 and Tr14, the HF crystal and 470-ohm shunt resistor, the two resistors and diode associated with the squelch circuit.

The original squelch control is replaced with a 2.5K. linear potentiometer, in series with a 2.2K resistor



The above photo shows the parts layout, presented in diagram form last month. Note that the components required for a carbon microphone are not included. Artwork for the printed wiring board is given below for the benefit of those who may care to make their own.



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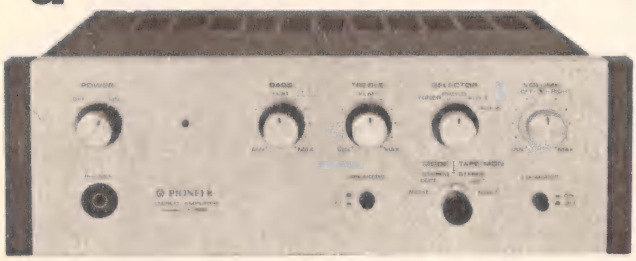
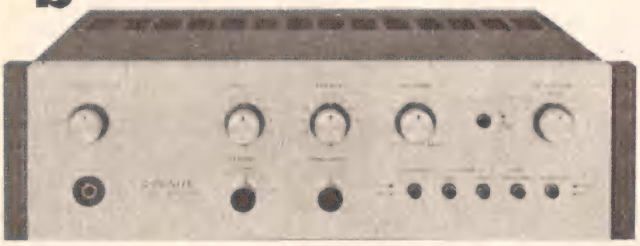
a



SA 500

Music Power Output:	44watt at 4ohm(dist. below·5%)
Continuous Power Output:	32watt at 4ohm(dist. below·5%)
Frequency Response:	20Hz to 50kHz ± 1db
Power Bandwidth:	20Hz to 40kHz(dist. below·5%)
S/N Ratio:	PHONO 75db) Volume: Max. tone AUX 90db) flat at rated output

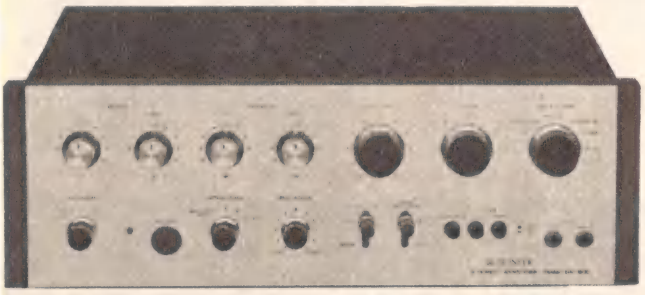
b



SA 700

Music Power Output:	120watt at 4ohm(dist. below·5%)
Continuous Power Output:	88watt at 4ohm(dist. below·5%)
Frequency Response:	20Hz to 40kHz ±1db
Power Bandwidth:	15Hz to 60kHz(dist. below·5%)
Harmohic Distortion:	Less than .05%(20watt at 1kHz)
S/N Ratio:	MAG 85db) Volume: Max. tone AUX 100db) flat at the rated) output — 1 HF.

c



SA 900

Music Power Output:	200watt at 4ohm(dist. below .3%)
Continuous Power Output:	168watt at 4ohm(dist. below .3%)
Frequency Response:	20Hz to 50kHz ±1db
Power Bandwidth:	20Hz to 50kHz(dist. .3%)
Harmonic Distortion:	Less than .08%(45watt at 1kHz)
S/N Ratio:	PHONO: better than 80db AUX: better than 95db (Volume: Max. tone: flat at rated output)

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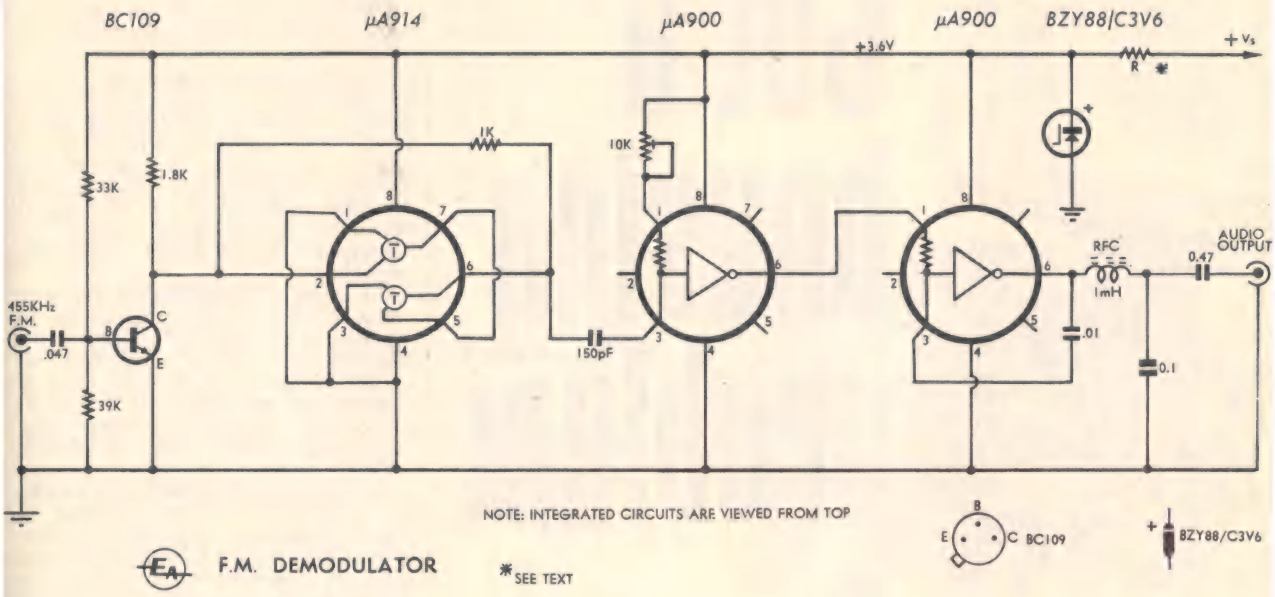


For experimenters and those interested in investigating its applications, here is a circuit for an FM demodulator which uses three integrated circuits and has none of the tuned circuits normally associated with FM discriminators. The only adjustment required is to set a preset potentiometer to suit the width of frequency deviation.

by Anthony Leo

There are a number of FM discriminator circuits which find application in television receivers and radio-telephone equipment. Perhaps the most frequently used discriminator is the "ratio detector," an outgrowth of the original Foster Seeley detector. A somewhat simpler circuit which is sometimes used in television receivers is the "quadrature detector." However, all of these detectors use rather special tuned circuits and the last mentioned can be particularly difficult to adjust.

Where only narrow frequency deviation is involved, as in radio-telephone communications as distinct from television, it is possible to use the band shape of an intermediate frequency amplifier in a receiver as a slope detector. Although this method is very simple, involving no special detector circuits, it relys on the amplitude frequency characteristic of the band shape being compatible with the frequency deviation involved.

However, the circuit shown requires no tuned circuits and has only one simple adjustment. The demodulator will provide an output voltage which is linearly proportional to frequency deviation when connected to the output of a suitable intermediate frequency amplifier. Our experiments were conducted with a 455KHz amplifier, but it would appear that any IF up to about 2MHz could be accommodated, requiring only one minor modification which will be described in detail later.

The demodulator can be used for any frequency deviation up to 100KHz peak-to-peak. It is thus suitable for both narrow band communication signals and TV sound signals. It should be emphasised, however, that it is essential to use an IF amplifier with a bandwidth consistent with the deviation involved. If a wide deviation sound signal, as from a TV channel, is fed to an IF of, say, 5KHz bandwidth, considerable distortion would result.

We tested the circuit in conjunction with the MOS FET converter described in the April issue, using the 1967 All Wave Receiver as a tunable IF. The 455KHz IF channel in this receiver is quite narrow, this being a feature of the design. For this reason many signals received on the 146MHz FM amateur net, and all TV sound signals, presented far too much deviation. It was necessary to heavily damp these tuned circuits in order to obtain adequate bandwidth.

Operation of the FM demodulator is relatively straightforward when considered systematically. A frequency modulated 455KHz signal introduced to the demodulator undergoes preamplification in a BC109 to bring it to an acceptable level for inuput to the first integrated circuit. Signal input to the BC109 should be 25mV or greater for reliable operation of the first IC.

The first IC, Fairchild type uA914, incorporated two dual gate inverters which are connected to provide a Schmitt trigger function. The frequency modulated sine wave signal introduced to the trigger is converted into a frequency modulated square wave and appears at the output terminals (6).

From here the signal is coupled to a second IC, which functions as a "one-shot multivibrator," delivering an output pulse of fixed width. But, as the input frequency is varying the pulse repetition rate at the output of the uA900 will also vary with modulation, resulting in a varying mark-space ratio in the pulse train.

Thus, having converted a signal of varying frequency into pulse form with varying mark-space ratio, it is a relatively simple matter to derive a voltage varying in amplitude according to the deviation in frequency. This is done by integrating the pulse train using a second uA900 buffer amplifier as an

active integrator. Output signal is taken from terminal 6 via a low pass filter consisting of a 1mH RFC and a 0.1uF capacitor.

As presented, the demodulator will cope with signals having a deviation of up to a maximum of plus and minus 50KHz. At maximum deviation the output swing is about 3V peak-to-peak. Naturally, the output voltage will be reduced with a smaller deviation.

With the restricted deviation of "narrow-band" FM the output is quite adequate to drive an amplifier of about 100mV input sensitivity. The 10K preset potentiometer should be adjusted for maximum output with a signal of small deviation. With signals of wide deviation the potentiometer should be adjusted for a symmetrical output voltage swing.

To adjust the demodulator for wide deviation, the potentiometer should be adjusted so that the DC voltage at the output terminal (6) is about 1.9V for an unmodulated carrier. A deviation of plus and minus 50KHz will then cause the output voltage to swing symmetrically between about 0.2V and 3.6V.

As we intimated earlier in the article, the demodulator could be used at higher frequencies up to 2MHz which is the limit imposed by the switching speed of the integrated circuits. The simple modification for operation at higher frequencies consists of reducing the value of the 150pF capacitor as frequency is increased. The capacitor value should be selected so that the DC output voltage can be set at 1.9V for an unmodulated carrier input. ■

52MHz HANDSET

(Cont. from p. 67)

fitted in the holes vacated by the crystal. The 20uF bypass capacitor from the emitter of Tr12 may now be earthed directly to any convenient point on the board.

The number of turns on L10 must be increased to 15 while L9, the supply line choke and bypass are removed completely. In their place is fitted a 10uH choke in parallel with a 3300 ohm resistor, forming the collector load for Tr12.

Alignment is accomplished by turning the "tuning" potentiometer maximum anti-clockwise and adjusting the slug in L10 to set the lower band edge at something a little below 52MHz. Turn the potentiometer to the opposite extreme and check the coverage, preferably with a signal generator. If the coverage is too great, increase the value of the 2.2K resistor in series with the pot as indicated earlier.

Peak L7 about 250KHz in from the bottom of the band, L6 in the middle and L8 about 250KHz from the top.

One or two spurious responses will be noticed as the tuning control is swung over the range. These are just about unavoidable in multiple conversion receivers without very careful shielding and filtering precautions being taken. We did not consider them annoying and were more than prepared to put up with them in order to have the added flexibility of a tunable receiver.

Next month: A version of this equipment for the 144MHz amateur band.

AN AUTOMATIC MORSE KEY

Sooner or later most dyed-in-the-wool CW operators think in terms of an automatic key; of the luxury of being able to send near perfect code with considerably less effort than is required with a conventional key. If you are one of the many who have thought about it. but done little more, then this article should inspire you to be up and doing.

by Eddie Roberts VK2ZJ and Philip Watson VK2ZPW

Automatic keys of one kind or another have been around for a long time, but, until comparatively recently, they have been mainly mechanical devices. Only with the advent of solid state devices has the electronic version really come into its own.

The basis of automatic key designs is the use of a laterally moving key or "paddle" in place of the vertical moving lever in a conventional key. The paddle, when moved in one direction (traditionally to the right) produces a series of correctly spaced dots for as long as it is held there. When moved to the left it is used to produce dashes, but in most mechanical designs these have to be timed and spaced manually. Nevertheless, the automatic dot facility represents a considerable improvement on the conventional key.

In mechanical keys the dots are produced by the mechanical resonance of a short horizontal lever. This is supported by a spring at one end and is free to vibrate at the other. The initial movement of the paddle in the dot direction sets it vibrating, opening and closing a set of contacts in the correct rhythm of dots and spaces. A small adjustable weight on the lever is used to select the speed required.

With the advent of the electronic key — which appeared first in valve versions — it became relatively easy to provide for the automatic production of both dots and dashes, along with the spaces between them. With such a key, all the operator needs to do is to move the paddle in the required direction, i.e., dot or dash, and hold it there until the required number of pulses have been generated. It is also quite simple to provide a degree of "memory" in the system, whereby a pulse, once initiated, will be completed and followed by a correct space, regardless of how the operator handles the paddle. Thus the operator has only to correctly nominate the number of dots and dashes required and provide correct spacing between letters and words; the key does the rest.

As is so often the case, the number of ways of doing this job appears to be limited only by the imagination of those who periodically address themselves to the problem. Designs vary from the very simple to the very complex; from relatively clumsy valve circuits to those employing the latest ICs. The designer of this unit has tried his hand at most versions and, while all did the job required of them, he feels that this is the simplest and most economical version he has yet seen.

The finished key in its cast aluminium box. The knob at the right hand end of the box is the "Rate Control." Holes in the top of the box are above the sidetone transducer.

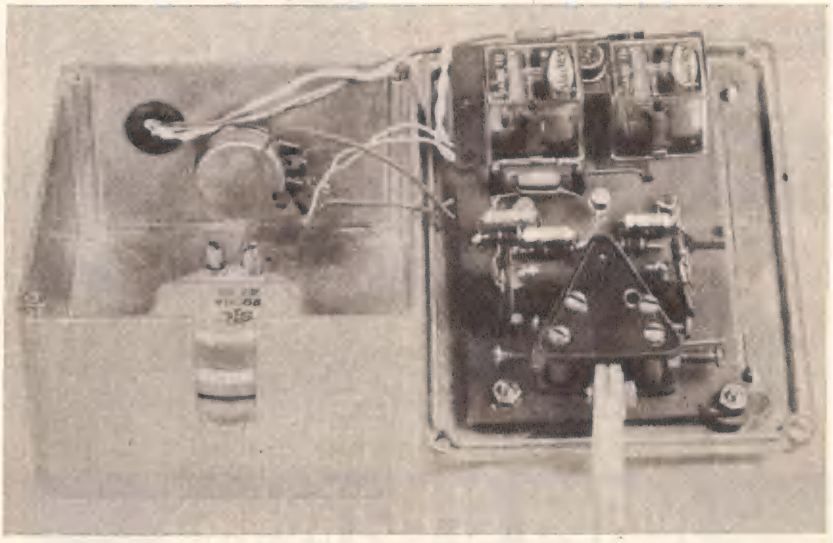
The main difference between this unit and the more elaborate ones is that it achieves its simplicity at the expense of two relays; devices which the "all-solid-state" adherents tend to scorn on the grounds that they are less reliable than their solid state counterparts.

On the other hand, it must be realised that even the most modern and elaborate designs very often have to sink their pride and call on the help of a relay to actually key the transmitter, since the voltage or current involved is often much too high to be handled in any other convenient manner. This being so, it was reasoned that the addition of a second relay could quite easily be justified if it eliminated a number of other components and simplified the circuit. The result is the design described here.

To understand how it functions first consider that portion of the circuit involving the paddle, the 3N140 FET, relay number 1, and associated minor components.

The "dash" contact on the paddle connects directly to the 9V supply rail, while the "dot" contact connects to a voltage divider tap (4.7K "Set Dot" pot.) which delivers a suitable lower voltage. Regardless of which voltage is selected it is connected via the normally closed contacts of relay 1 to the gates of the 3N140. These gates are connected to the negative rail via a 0.1uF capacitor and a 2.2M pot in parallel with a 4.7M resistor. Thus the voltage selected by the paddle is applied across the 0.1uF capacitor.

As a result, the capacitor charges to a value equal to the selected voltage,



An inside view of the key. In the box on the left is the sidetone transducer and "Rate Control" pot. On the right is the printed wiring board and paddle assembly. The battery is external.

and does this almost instantaneously, since there is very little resistance in the circuit. Prior to the capacitor being charged, the 3N140 is biased "off" by reason of the source being connected to a positive point, relative to the gate, formed by the junction of the 820 and 220 ohm resistors. Thus there is no current flow in the drain circuit and the drain is virtually at the full positive rail voltage.

When the capacitor is charged, the gates become positive relative to the source, the FET conducts, and the drain moves in a negative direction (i.e., becomes less positive). Prior to this the first BC178 (associated with relay 1) has been in a non-conducting condition since the base and emitter were both at the same potential. However, as the drain of the FET moves toward the negative rail, the base of the BC178 is forward biased and the transistor conducts.

This energises relay 1, opens the normally closed contacts and removes the supply voltage from the FET gate. The 0.1uF capacitor now commences to discharge through its shunt resistors, eventually reaching the point where the gates are no longer positive with respect to the source. The drain current consequently falls, removing the forward bias on the BC178, which in turn causes relay 1 to drop out.

The length of time needed for this to happen depends on the values and characteristics of all the components involved but, assuming that these are fixed, the main variable is the value of voltage used to charge the 0.1uF capacitor. If this is the larger of the two voltages the capacitor will take longer to discharge than if it is the smaller and this ratio can be adjusted to satisfy the conventional three-to-one dash-dot ratio.

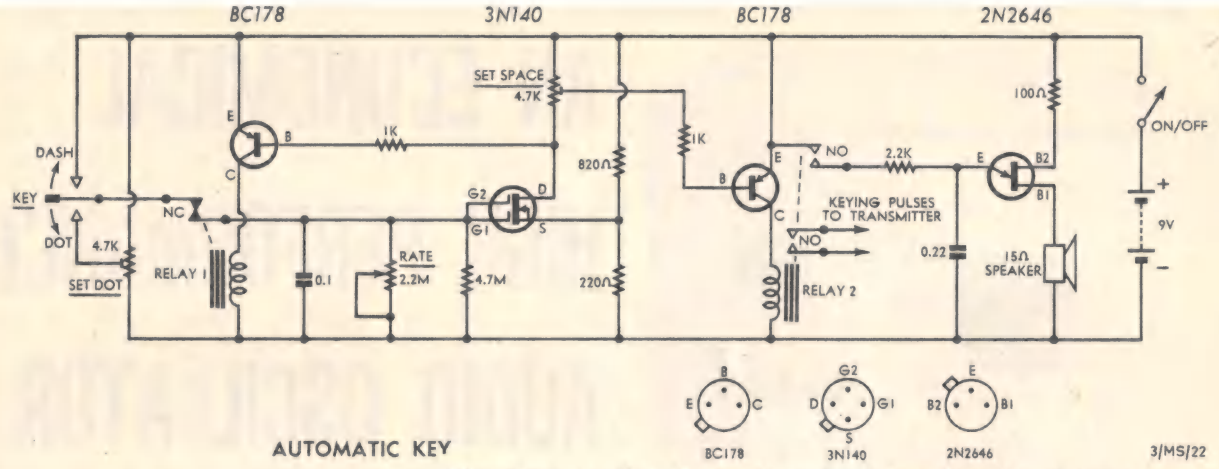
The only other deliberate variable in this part of the circuit is the 2.2M pot. This controls the rate of discharge of the 0.1uF capacitor and, therefore, the length of both dots and dashes. It thus becomes a "Rate Control" which the user adjusts to suit his own requirements.

When relay 1 drops out and its contacts close it will encounter one of two possible circuit conditions; either the paddle will be activated in one direction or the other or it will be in the neutral position. If it is in the neutral position the relay will remain out. If it is an energising position the relay will immediately pull back in and initiate another dot or dash cycle, depending on the paddle contact selected.

In this regard it should be noted that the reaction of the relay is very fast; so fast that it cannot normally be detected visually when using the small, lightweight armature relays fitted to the original model. Only by very close observation, under favourable lighting conditions, can any movement be detected.

Up to this point we have succeeded in generating either long or short pulses, capable of being adjusted to have the correct ratio. However, they are of little practical use since the space between them is far too short; no more than the few milliseconds needed for relay 1 to drop out and pull in again.

This brings us to the second BC178 transistor and relay 2. These function



The circuit is relatively simple and a full explanation of its operation is given in the text. The sidetone oscillator on the right of the circuit, and the relay contacts to operate it, are optional.

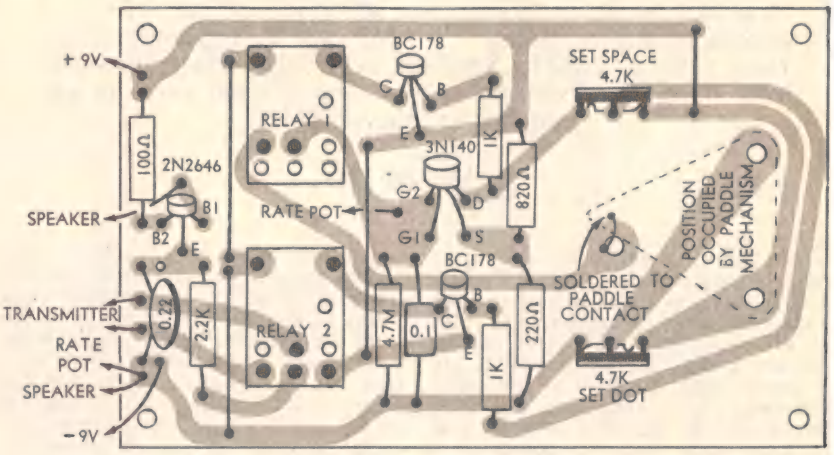
in the same manner as relay 1 and its associated BC178 except that the second BC178 takes its drive from an adjustable tapping on the drain load of the 3N140. Because this tapping is closer to the positive rail, less forward bias is applied to the BC178. This means, in turn, that relay 2 will drop out earlier than relay 1 during any discharge cycle of the 0.1uF capacitor. This produces the required spacing and the pot. concerned is logically marked "Set Space." The closer the moving arm is set toward the positive rail, the longer will be the space.

One set of contacts on relay 2 is used to key the transmitter while a second set controls a small unijunction oscillator, the 2N2646 and associated components, called a "sidetone" oscillator. This provides a monitoring signal and is an optional feature. Experienced operators, or those whose equipment already provides such monitoring facilities, will not need it. On the other hand, most operators need some practice when they encounter an automatic key for the first time, and the oscillator is invaluable for this.

Summarising the circuit, we can make the following points: A dot or dash pulse, once initiated, will be completed, together with a correct space to follow it, regardless of what is done with the paddle. If the paddle is held in one position the circuit will generate a succession of dots or dashes, as appropriate. The length of the dot can be varied to satisfy the three-to-one dash-dot ratio, the space following a dot or dash can be varied to suit the "space equal to one dot" requirement, and the speed of all these functions can be varied in unison to suit the speed at which the operator wishes to work.

Setting up the key to give correct dot, dash and space times is quite simple. All that is needed is the ohmmeter portion of a multimeter. Connect this across the keying terminals of relay 2, set the "Rate" control for a fairly fast response, hold the paddle in the dash position, and adjust the "Set Space" pot. for 75 per cent of full-scale deflection.

Set the paddle to the dot position and adjust the "Set Dot" pot. to give 50pc full scale deflection. It is essential to carry out these adjustments in the above sequence. There may be some slight variation in the ratios when the rate is varied from very fast to very slow, but this is of negligible importance.



The component layout, from above the board, superimposed on the printed wiring pattern beneath the board. This diagram is a little less than full size. Commercial printed wiring boards should be available, or full size photographic copies of the pattern may be purchased through the information service for 50c. External connections shown on the left of the diagram were fitted as flying leads in the original, but could be terminated in suitable terminals or sockets. Note area of paddle mechanism at right.

PARTS LIST

1 Die cast aluminium box 4½in x 3in x 2in (internal). Eddystone 6908P or similar.
1 Printed wiring board type 70/k6
2 Relays. Varley type VP2/CAB/ 12/185 ohm or similar
1 3N140 FET (RCA)
2 BC178 transistors (Mullard)
1 2N2646 unijunction (G.E.)
1 9V battery 276-P or similar
1 Plug for above
1 Miniature speaker 15 ohms or low impedance earphone. (See text.)

RESISTORS (½W)

1 100 ohm.	*1 2.2K*
1 220 ohm	*1 4.7M*
1 820 ohm	*2 4.7K tab pots*
2 1K	*1 2.2M pot*

CAPACITORS

1 0.1uF metallised polyester
1 0.22uF metallised polyester

As a matter of interest the correct length of pulses and spaces involved in the manufacture of code characters is as follows: If the length of a dot is taken as a unit period, a space is equal to one unit period, a dash is three unit periods, the space between letters is three unit periods, and the space between words is seven unit periods.

Note, however, that there may be exceptions to these rules. Many instructors believe that, regardless of how low the "words-per-minute" rate may be for purposes of instruction, the rate at which each character is sent should be representative of the ultimate speed the student wishes to acquire. In this way he is presented with the correct sound of the character as it will be when transmitted at normal speed.

The electrical side of the circuit should present no constructional problems. Layout is not critical and virtually any arrangement which suited the constructor could be used. The original unit was constructed on a home-made

(Continued on page 81)

AN ECONOMICAL HIGH PERFORMANCE AUDIO OSCILLATOR

Here is a simple audio oscillator which will deliver sine-wave output of approximately 1V RMS over a frequency range from 15Hz to 20KHz. While it uses only three transistors, total harmonic distortion is less than 0.1 per cent for all frequencies above 60Hz.

By LEO SIMPSON

SPECIFICATIONS

Frequency range: From 15Hz to 20KHz in one range.
Output Voltage: 0-1V and 0-50mV RMS at an output impedance of less than 600 ohms.
Distortion: Total Harmonic distortion is less than 0.1 per cent over the range from 60Hz to 20KHz and less than 0.2 per cent over the range from 15Hz to 60Hz. The distortion may be reduced, with the aid of a harmonic distortion analyser as a reference, to less than 0.05 per cent over the range from 60Hz to 20KHz.
The output level is flat within 0.5dB over the full frequency range.

Apart from a multimeter, one of the most useful pieces of test equipment available to the audio enthusiast is an audio frequency generator. The uses to which a simple instrument can be put are many and, of course, its use is certainly not confined to the audio enthusiast. Any service shop or laboratory worthy of the name must have at least one audio frequency generator.

In the past, we have published many AF generators, the two most recent being those published in December, 1967, and September, 1968. These two instruments featured the same oscillator circuit, very low distortion, metered output and low output impedance. The September, 1968, instrument had a very high performance specification indeed and, at the price, represented a considerable saving in comparison with commercial laboratory grade AF generators.

While the above instruments have been attractive in terms of performance, we felt that the average hobbyist may have been deterred by the relative complication of the circuit—if one can call a four transistor circuit complicated. It was with interest, then, that we noted a circuit submitted by C. A. Pye to the "Circuit Ideas" page of the January, 1970, issue of "Wireless World." The circuit involved a Wien bridge oscillator which employed a field effect transistor at the input to reduce damping on the bridge. This allows the use of high value ganged potentiometer to cover the audio frequency spectrum without the need for range switching. We felt that this circuit could be very attractive to the average audio enthusiast.

The oscillator described in the following paragraphs is based on the circuit published in "Wireless World."

For those not familiar with the operation of the Wien bridge the following description should clarify matters. The basic circuit configuration is as shown in figure 1. It consists of a high-gain amplifier with two separate feedback circuits. One circuit, consisting of R1, R2, C1 and C2, connects from the amplifier output back to the positive (or non-inverting) input and thus provides positive feedback; the other circuit consists of R3 and the thermistor (a negative temperature-coefficient resistor) and is connected between the amplifier output and the minus (or inverting) input and thus provides negative feedback.

"Positive feedback" refers to the condition where the signal being fed back to the input is in phase with the input signal and thus adds (to the input signal). "Negative feedback" refers to the condition where the signal being fed back to the input is 180 degrees out of phase with the input signal and thus subtracts from the input signal.

The configuration in which R1, R2, C1 and C2 are connected is known as a "Wien network" which is capable of performing in a manner similar to that of a series LC tuned circuit. At a particular frequency, determined by the values of the four elements, the transmission loss of the network falls to a minimum while the phase shift also falls to zero.

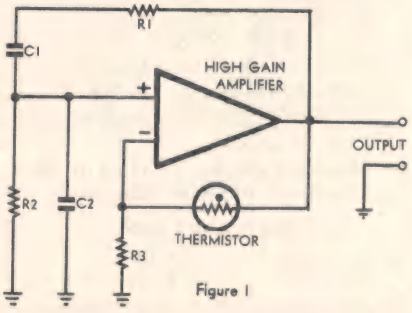


Figure 1

Above is the schematic of a Wien bridge oscillator showing the high gain amplifier and its associated positive and negative feedback networks.

This "pseudo-resonance" occurs at frequency Fo, where Fo may be found from the following equation providing the driving source impedance is negligibly low compared with the series elements (R1, C1) and the output loading impedance is negligibly high compared with the shunt elements (R2, C2):

$$Fo = \frac{1}{2\pi \sqrt{R1.R2.C1.C2}} \quad \ldots (1)$$

where the relevant quanities are in Hertz, Ohms and Farads.

If R1 and R2 are made equal in value, and C1 and C2 similarly given equal values, equation (1) reduces to

$$Fo = \frac{1}{2\pi RC} \quad \ldots (2)$$

In this case the transmission loss falls at Fo to a minimum of 3.0; in other words there is a maximum transmission "gain" of 0.33. The phase shift is zero as before.

For a feedback amplifier to produce sustained oscillations at a particular frequency, the overall loop gain must be at least unity and the phase shift either zero or a multiple of 360 degrees. This means that the amplifier must have a gain at least equal to the loss of the positive feedback network and have a phase shift such that the ouput produced in response to the feed-

back signal is synchronous (in phase) with the output signal from which the output signal was derived. Hence for the circuit of figure 1 to produce continuous oscillations at the "pseudo-resonant" frequency, the amplifier gain must be at least 3 to compensate for the loss in the Wien network.

While it is necessary for the amplifier to have an overall loop gain of at least unity for sustained oscillation to occur, if the gain does happen to be more than one, the oscillations will continue to grow until the amplifier is driven well into clipping. To maintain the gain accurately at a figure of unity and oscillation at constant amplitude, a thermistor is used in the negative feedback nework.

Since the thermistor has a negative temperature coefficent of resistance, its resistance falls as its temperature rises. Hence when power is first applied to the circuit of figure 1 the thermistor will have a relatively high resistance and thus there will be little negative feedback. The resulting high gain around the positive feedback loop will rapidly build up oscillation.

As the oscillations grow, the temperature of the thermistor will rise also, as the latter and resistor R3 are effectively connected in series across the amplifier output and will accordingly draw signal current. Hence the resistance of the thermistor will fall, the negative feedback will increase and the effective amplifier gain will drop.

It should be apparent that an equilibrium will be reached, as the output amplitude can only rise to the point where the thermistor has increased the negative feedback on the amplifier to correspond to an effective gain of 3 times—giving unity loop gain. If the oscillation amplitude tends to rise above this level, the thermistor will reduce the loop gain slightly below unity and the oscillations will begin to die away; conversely if the amplitude tends to fall, the thermistor will increase the loop gain slightly above the unity to correct it.

In short, the "non-linear" negative feedback action produced by the thermistor acts to continuously and automatically maintain the loop gain accurately at unity, and the oscillation amplitude constant. By employing a thermistor with a suitable temperature/resistance characteristic, the output amplitude may be maintained at a level well below amplifier limiting, and the output waveform may thus be arranged to have low distortion.

The actual distortion in the output will depend largely upon the linearity of the amplifier itself. In other words, to produce a low distortion oscillator it is necessary to base the design on an amplifier having very low distortion at signal levels below limiting (or clipping). Further, it is possible to hold the distortion to an absolute minimum by using only a small proportion of the available output voltage swing. With the amplifier and supply voltage used in our case, the available voltage swing is approximately 17 volts peak-to-peak, but we have restricted the output voltage to 1 volt RMS (2.83 volts peak-to-peak).

For minimum distortion in a Wien bridge oscillator the Wien network should be fed from a low output

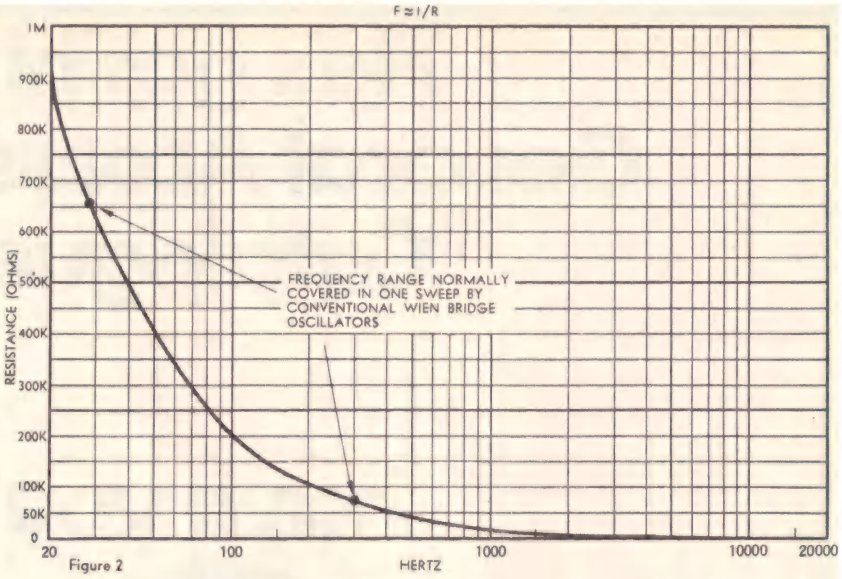
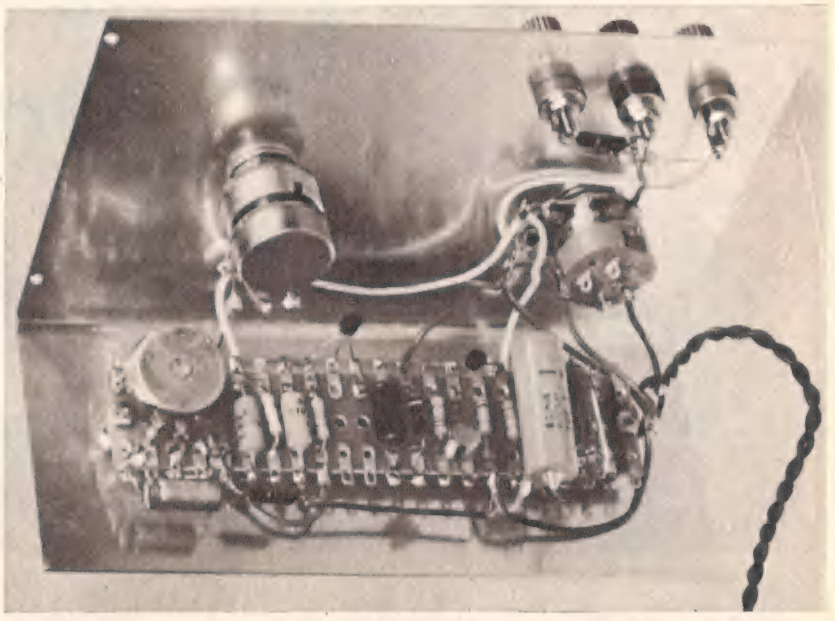


Figure 2

This hyperbolic curve shows the rapid change of frequency for small change in resistance, at high frequency settings of the oscillator. It illustrates the reason for the cramped frequency scale.

At left is a view inside the plastic case showing details of the battery mounting.



This view shows the simple wiring layout behind the front panel. Note that a miniature trimming potentiometer could be used in place of the tab-mounting type that we have used.

impedance and it should feed into a high input impedance. These conditions place minimum loading on the network so that the "Q" of the pseudo-resonance referred to above, is high.

While essentially a simple device, the amplifier used in the present oscillator satisfies the above requirements very well. Direct-coupled throughout, it contains only three transistors. The field-effect transistor at the input satisfies the requirement of a high input impedance for the Wien network. Following the FET is a high gain PNP silicon transistor which combines with the FET to provide very high open loop gain (i.e., gain before any feedback is applied). Following the PNP transistor is a silicon NPN transistor functioning as an emitter follower. It provides a low output impedance, both for feeding the Wein network and the external load.

Positive feedback is applied from the output via the Wien network to the gate of the FET while negative feedback is applied via the thermistor to the Source electrode of the FET.

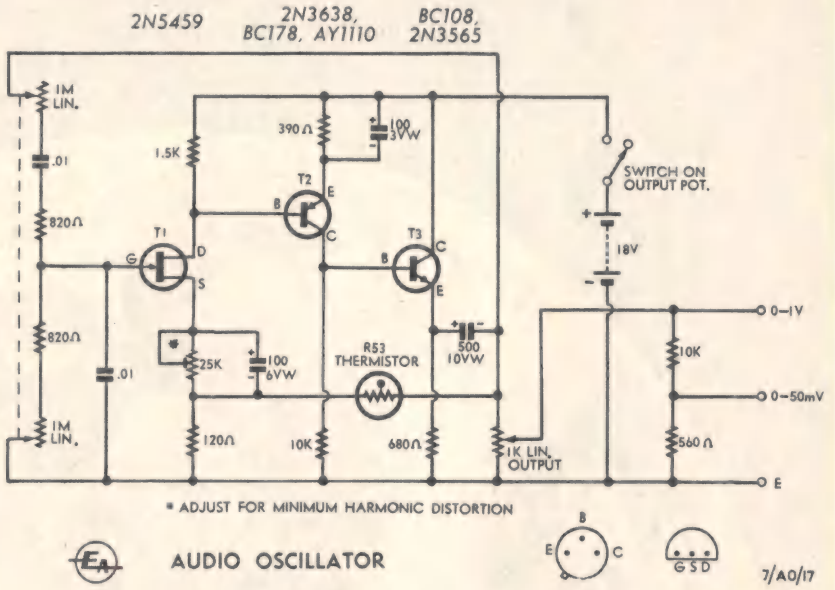
(Readers with a background in valve technology will realise that the requirements of high input impedance and low output impedance have been met by valve line-ups ending in a cathode follower stage. However, using valve technology, it would be difficult to match the hum-free, high-gain, low phase shift characteristics of this simple amplifier and therefore difficult to duplicate the performance specifications.)

Having described the approach to a low distortion oscillator, we find that the actual distortion level produced by the oscillator depends on the DC operating conditions in the three stages of the amplifier. There will be a particular operating point at which the distortion will be a minimum. This corresponds closely with the "half supply voltage" condition at the emitter of the output transistor. This voltage is set by varying the gate-source bias of the FET and this, in turn, will affect the DC operating conditions in the two succeeding stages. The gate-source bias of the FET is set by varying the 25K preset resistor in the source circuit.

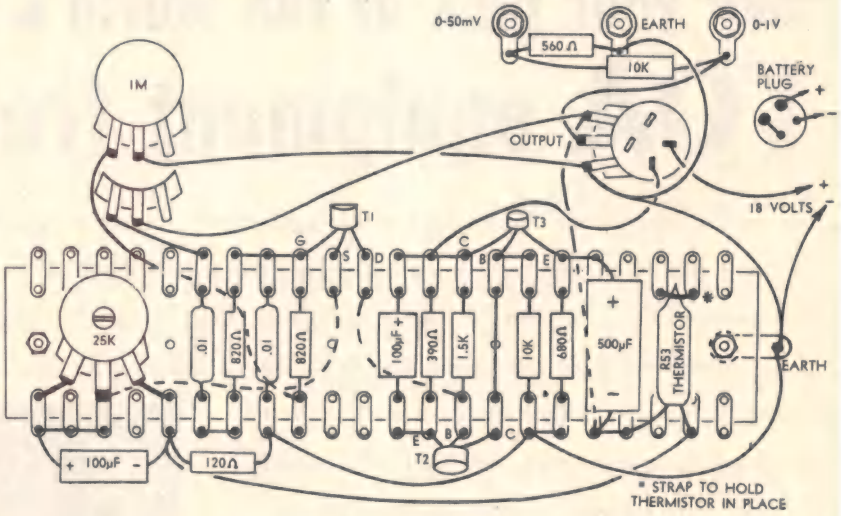
The best way to set the "half-supply" voltage at the output is to monitor the current drain of the complete amplifier with a milliameter and vary the 25K preset resistor until the current is between 13 and 14mA. The prototype actual gave the lowest distortion (0.04 p.c.) with the current set to 13mA. With the setting as described, the distortion will be below 0.1 per cent but the actual minimum distortion condition can only be found by trial and error with the aid of a distortion analyser or wave analyser.

While the use of a FET in the input stage of the amplifier has the advantage of light loading on the Wien network, it also enables the variable resistor elements in the network to have high values. This makes it possible to cover a large frequency range using an ordinary ganged 1-megohm potentiometer, though there is one serious disadvantage in attempting to cover such a range in one sweep. Reference to equation 2 above will show that, if the capacitive elements are constant, the output frequency will be a hyperbolic

CIRCUIT OF THE OSCILLATOR



The circuit of the oscillator contains only three transistors but can be adjusted to give very low distortion over the whole frequency range. The complete wiring diagram of the oscillator is below. Note that the battery connector should be wired as indicated otherwise one section will be shorted out.



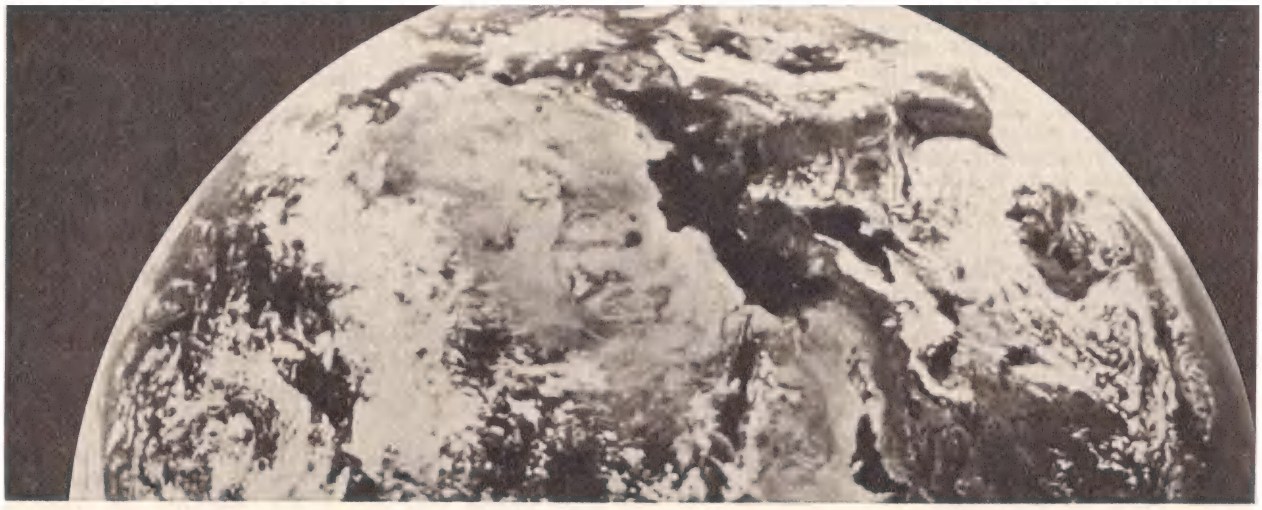
PARTS LIST

1. Case 7½ x 4½ x 4½in, with anodised aluminium front panel (See text).
1 Battery (Eveready 2512 or equivalent) and plug to suit.
1 22-lug tagstrip.
1 2M linear dual ganged potentiometer.
1 25K preset potentiometer.
1 1K linear potentiometer with switch.
1 Thermistor, STC type R53 or equivalent.
3 Screw terminals, 2 red, 1 black.
1 2N5459 N-channel FET.
1 2N3638, AY111, BC178 silicon PNP transistor.
1 BC108, 2N3565 silicon NPN transistor.

CAPACITORS
(higher voltage ratings may be used)
1 500uF/10VW electrolytic.
1 100uF/6VW electrolytic.
1 100uF/3VW electrolytic.
2 0.01uF/160VW 5 per cent polyester or metallised polyester.

RESISTORS
(½ or ¼ watt rating)
2 x 10K, 1 x 1.5K, 2 x 820 ohms, 1 x 680 ohms, 1 x 560 ohms, 1 x 390 ohms, 1 x 120 ohms.

SUNDRIES
1 large knob and thick plastic film for pointer, 1 small knob, aluminium for battery clamp, spacers, screws, nuts, solder lugs, hook-up wire and solder.



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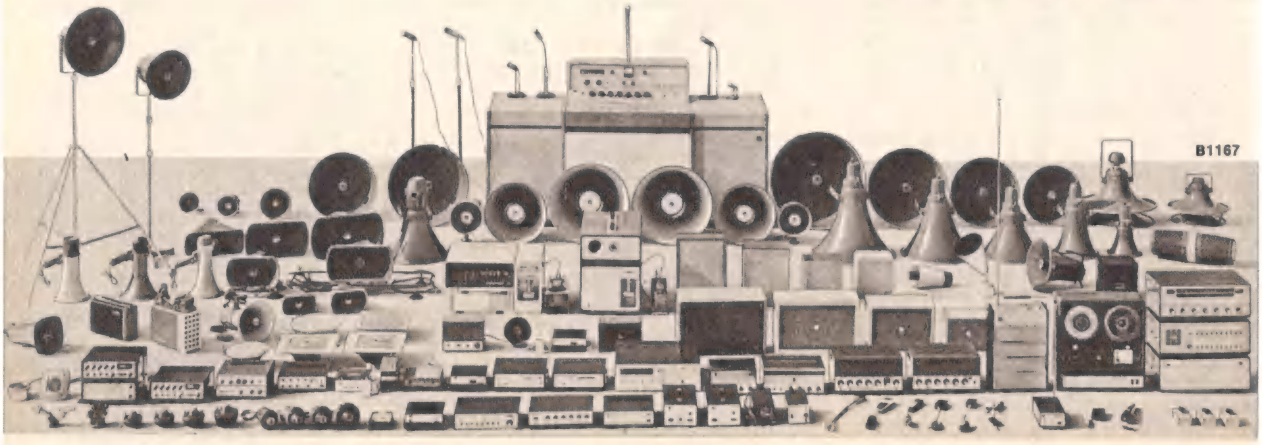


function of R:

$$Fo = \frac{k}{2\pi R} \quad \ldots (3)$$

This means that, at high frequency settings, small changes in resistance will cause large changes in frequency and thus the frequency scale at the high end will be very cramped. Reference to the graph in figure 2 will illustrate the problem. In practice, the more pretentious RC oscillators are designed to cover a frequency range of about 10:1 which avoids, to some extent, the problem of scale cramping. The present simple oscillator covers from 15Hz to 20KHz in one sweep, which is a range of approximately 1300:1. The use of logarithmic curve resistance elements does little to alleviate the problem and in any case, accurately matched logarithmic potentiometers are almost unobtainable and expensive to boot.

As the oscillator is intended mainly as an economy unit, we do not feel that the scale cramping is a serious drawback. If constructors feel that it is not satisfactory, they should build either of the signal generators described in the September, 1968, or December, 1967, issues of "Electronics Australia." These instruments have a conventional range switching system and also have the advantage of slightly better "envelope stability." (Editorial note: Copies of these articles are available from our Information Service at 20c each. File Nos. 7/AO/16 and 7/AO/13.)

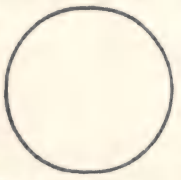
The term "envelope stability" refers to stability of the amplitude of the signal and to the time taken for the amplitude to stabilise after the circuit has been disturbed by a change in frequency or range setting. In the instrument described here, the amplitude stability (or envelope stability) is mainly a function of the variable resistive elements. If the potentiometer has poor wiper contact then the amplitude stability will be poor.

An alternative to the single-sweep but cramped scale, is to build the unit as a switched frequency instrument. A two-pole, eleven-position switch can be used with appropriate resistors to replace the ganged potentiometer, giving a number of suitably spaced frequencies. Suitable resistor values for eleven frequencies are given in the following table. These can be calibrated "spot-on," if necessary by padding with higher value resistors.

20KHz	820 ohms
10KHz	1,650 ohms
7KHz	2,360 ohms
5KHz	3.3 kilohms
3KHz	5.6 kilohms
1KHz	16.5 kilohms
700Hz	23.6 kilohms
400Hz	41.0 kilohms
100Hz	165.0 kilohms
50Hz	330.0 kilohms
30Hz	560.0 kilohms

The available output from the generator is approximately 1 volt RMS at maximum setting of the 1K level potentiometer. As settings of the level potentiometer are rather critical for low level settings, an additional fixed potential divider has been provided. The division ratio is approximately 20:1, so that the low level output is variable over the range from 0-50mV. The low level output resistance will approximate 560 ohms while the high level output impedance will be somewhat lower than this again.

These Lissajous figures show (left to right) vertical-to-horizontal frequency ratios of 1:1, 2:1 and 3:1.



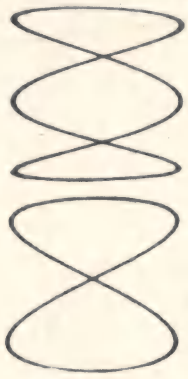


Figure 3b

These Lissajous figures show vertical-to-horizontal frequency ratios of 1:2 (top) and 1:3 (bottom.)

CONSTRUCTION: The prototype instrument was housed in a moulded plastic case with front panel of anodised aluminium. The case measures 7¼ x 4¼ x 4¼in approximately and is marketed by the Australian Transistor Company, P.O. Box 74, Mount Waverley, Victoria. It is available from most part suppliers. The N.S.W. distributor is Watkin Wynne Pty. Ltd., 32 Falcon St, Crow's Nest.

The thermistor is an STC type, R53, of glass construction. It is soldered directly into circuit and the glass bulb is prevented from vibrating by a loop of wire around it which is soldered to the board.

The majority of components are mounted on a 22-lug section of miniature tagboard. The wiring is straightforward but the layout shown in the wiring diagram and accompanying photograph should be followed to avoid any mistakes. The preset potentiometer (connected as a resistor) is soldered directly to the tagboard.

The battery is an Eveready 2512, a 2 x 9-volt type. Take care to wire the connecting plug as shown in the wiring diagram, otherwise one section of the battery will be shorted when the plug is inserted. The battery is held in place by a clamp made from a 4½ x 1in piece of 18-gauge aluminium.

The plastic pointer on the frequency control knob was made by cutting a piece of thick plastic film to suitable shape. A line was scribed on it as shown in the photograph and filled in with Indian ink. The pointer was secured to the knob with Araldite.

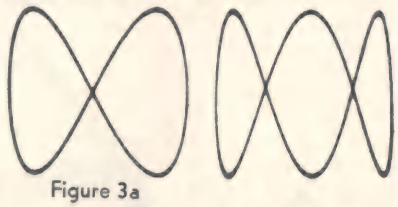
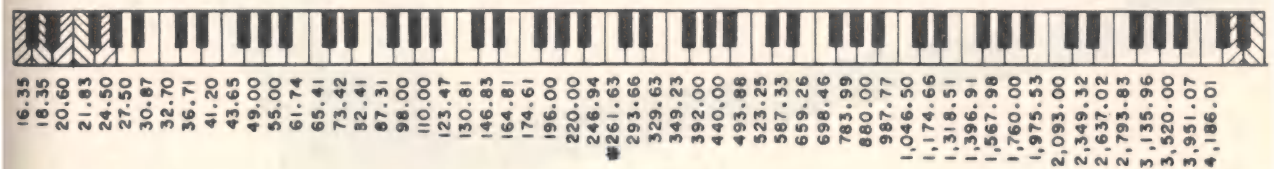


Figure 3a

Two questions remain, that of calibration of the frequency scale and the use of an alternative mains power supply. Taking the frequency scale first, the scale shown in the photograph of the prototype will serve as a model for constructors.

Two basic methods can be used for frequency calibration. The first is to use a digital frequency meter to indicate the oscillator's frequency directly. The second method is to generate Lissajous figures with the aid of an oscilloscope and another known source of audio frequencies. The second source could be an accurately calibrated oscillator, a test record, an electronic organ or the mains frequency, 50Hz.

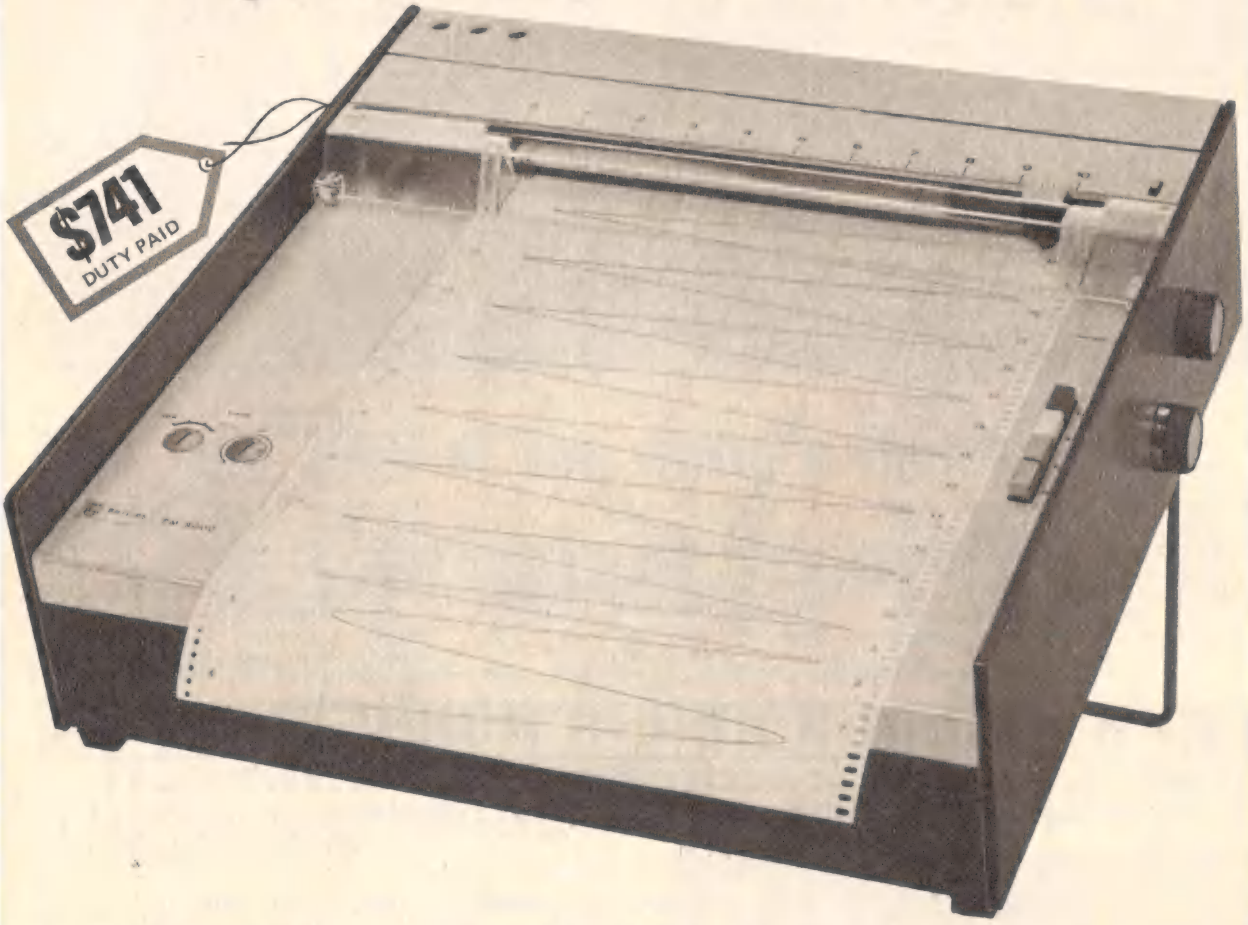


Shown above are the frequencies in Hertz of the white notes on a piano or organ keyboard at fundamental 8ft pitch. Middle C is marked with an asterisk. Those notes which approximate multiples of 100Hz can be used to calibrate the oscillator if no other source is handy. On an organ, 4ft pitch doubles and 2ft pitch quadruples all frequencies shown.

For those not familiar with the Lissajous figure method of frequency comparison, the following paragraphs will briefly outline the procedure. Basically, the idea is that the output of the "known" frequency source is fed to the horizontal deflection amplifier of the CRO and the output of the oscillator to be calibrated, the "unknown," is fed to the vertical deflection amplifier. Then, when the gains of the two deflection amplifiers are suitably adjusted, a series of patterns known as Lissajous figures are produced. Typical frequency patterns are shown for the guidance of readers. These enable the unknown frequency to be calculated easily.

These figures differ from the normal

Philips portable flat-bed recorder PM8000 priced below any other recorder in its class.



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pattern produced by a sine wave oscillator, since the horizontal deflection signal is a sine wave and not the normal sawtooth signal produced the oscilloscope timebase generator.

Some examples of Lissajous figures are shown in figure 3a. Each represents a different frequency ratio, as follows: 1:1, 2:1 and 3:1. Each ratio is that of the vertical frequency to the horizontal frequency. For example, if the signal applied to the horizontal deflection amplifier of the CRO is 50Hz and the resulting ratio is 2:1, then the vertical frequency, for the appropriate Lissajous figure shown in figure 3, is 100Hz.

The method of determining the ratio is to count the loops along the top of the pattern and the number of loops along one side. The ratio of the two numbers is the desired frequency ratio.

Properly interpreted, this basic rule can allow one to identify a variety of ratios. For example, five loops along the top and two at the side would indicate a ratio of 5:2 and, related to 50Hz, this would indicate a frequency of 125Hz. As such patterns become more complex, they become progressively more difficult to interpret and, for our present purpose, it will probably be sufficient to work with simple multiples, giving 50Hz, 100Hz, 150Hz and so on, as already expalined.

Incidentally, submultiples can be identified in the same way and figure 3b indicates the pattern shape for ½ and 1/3 of 50Hz, corresponding to 25Hz and 16.7Hz.

If the reader attempts to simulate these patterns on an oscilloscope he will quickly find that the patterns will tend to drift. This is because the phase relationship of the two frequencies is changing because of small frequency drift of the two sources. In practice, unless the two sources are very stable, the circle pattern shown in figure 3 will slowly change from a circle to an ellipse to a straight line as the phase relationship of the two signals change. A circle represents a phase difference of 90 or 270 degrees while a straight line represents a phase difference of zero or 180 degrees. This slow drift in the pattern will only be a portion of a cycle so there is no need to worry about the resulting calibration accuracy.

As the frequencies increase it becomes more difficult to hold the pattern steady on the screen. However, errors introduced by the frequency difference will still be small compared to normal calibration errors. Beyond a ratio of 10:1 the pattern is very hard to read and another frequency, higher than 50Hz, should be used for calibration above 500Hz.

As already mentioned, other possible sources of known frequency would include frequency test records and an electronic organ. By deriving a signal for the playback or organ amplifier, Lissajou patterns on the face of a CRO can be used for frequency comparison.

Those with an ear for music may not need a CRO to set the oscillator against an electronic organ or even a piano.

A list of frequencies for the centre octave of an accurately tuned keyboard instrument was published on pages 95-97 of the September 1969 issue. Frequencies for any note on the keyboard can be derived from these lists and for voices pitched one or two octaves above or below the note key signature.

As a further guide we have reproduced portion of a diagram from The New Fisher Handbook with the frequencies marked against the white notes of a keyboard.

When we initially built the prototype we rejected the idea of a mains power supply as this was intended as an economy instrument. In addition, mains power supplies for oscillators can cause problems at low frequencies, the oscillator frequency tending to beat with the mains frequency and its harmonics to produce large changes in amplitude.

However, we have shown a simple power supply in figure 4 for those who may prefer it. It should be constructed in a steel case and kept isolated from the plastic case of the oscillator to reduce hum injection to a minimum. This power supply will enable the low distortion figures claimed for the oscillator to be achieved at frequencies above 200Hz but, below this frequency, the rising supply inpedence will restrict the total harmonic distortion to a minimum of about 0.25 per cent. ■

The circuit of a simple mains power supply for the oscillator.

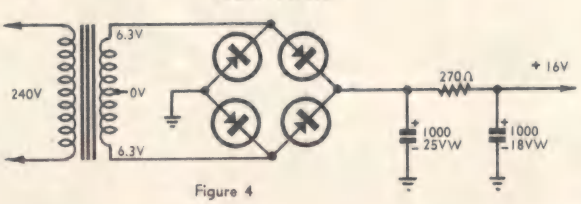

Figure 4

AN AUTOMATIC MORSE KEY

(Continued from page 73)

printed wiring board measuring 4¼in x 2-9/16in. We have prepared a copy of this pattern, which is reproduced here. This will be distributed to the trade and commercial versions should be available.

The unit is housed in a die-cast aluminium box measuring 4¼in x 3in x 2in (internal). These units are available commercially, one version being the Eddystone 6908/P. The printed wiring board is mounted on what is nominally the "lid" of the box, using 1/8in Whit. screws and spacers. The body of the box accommodates the "Rate" pot. and the sidetone transducer.

This latter can take a number of forms. The circuit shows a miniature 15 ohm speaker, but the original unit used a rocking armature telephone receiver insert, STC 29-SU-8A, with an impedance of 300 ohms. Almost anything in between these two extremes would appear to be satisfactory, the only significant effect being to change the pitch of the note. This can be compensated for by varying the 2.2K resistor and/or the 0.22uF capacitor in the emitter circuit of the 2N2646.

The paddle is mounted on the printed wiring board. Again, the form of construction is up to the individual, depending on his mechanical skill, workshop facilities, and his preferences in regard to the "feel" of the finished movement.

Some idea of the construction of the original may be gained from the photographs. It consists of two triangular shaped pieces of bakelite separated by four brass spacers. Two of the spacers are at the front (base) of the triangle and are tapped horizontally to take 1/8 in Whit. screws. These screws form the contacts for the dot and dash circuits. Behind them are two more spacers, similarly drilled and tapped, but which are used to wedge two rubber blocks against opposite sides of the paddle lever. The paddle lever is a strip of brass, thick enough to be rigid, which is soldered to a simple axle supported vertically at the apex of the triangle. One end is visible in the photograph.

The paddle proper consists of two pieces of Perspex suitably shaped and bolted to each side of the paddle lever. A deep inverted "U" cut-out in the die-cast box accommodates the paddle.

The relays used in the original were Varley type VP2/CAB/12 with a coil resistance of 185 ohms, and the printed wiring board has been designed to take these. Similar relays are also made by Siemans and ITT. However, apart from the requirements of the printed wiring board, the choice of relays is not particularly critical. Almost any relay having similar electrical characteristics and contact arrangements can be used.

In fact, for those who fear that conventional relays are less reliable than they would like, it should be possible to substitute dry reed relays, using either commercial or home-made coils. For relay 1 a changeover reed would be most suitable (Hivac XS/11) since it provides a normally closed facility. For relay 2 a single reed (Hivac XS/14) would suffice if no sidetone facility was required or two such reeds in a single coil if the sidetone oscillator is to be retained.

Naturally. the use of any of these alternative relay types will make it less convenient to use the printed wiring pattern, but this is not essential and the choice of a relay may make it worthwhile to consider alternative forms of construction. ■

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BSR:P 104

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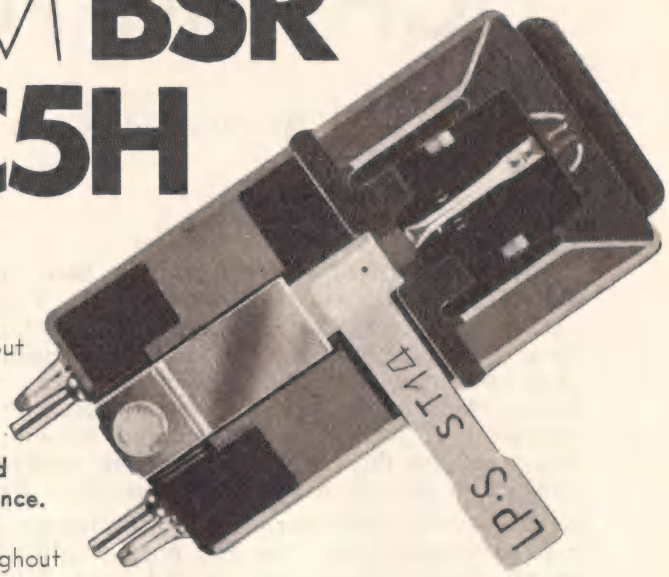

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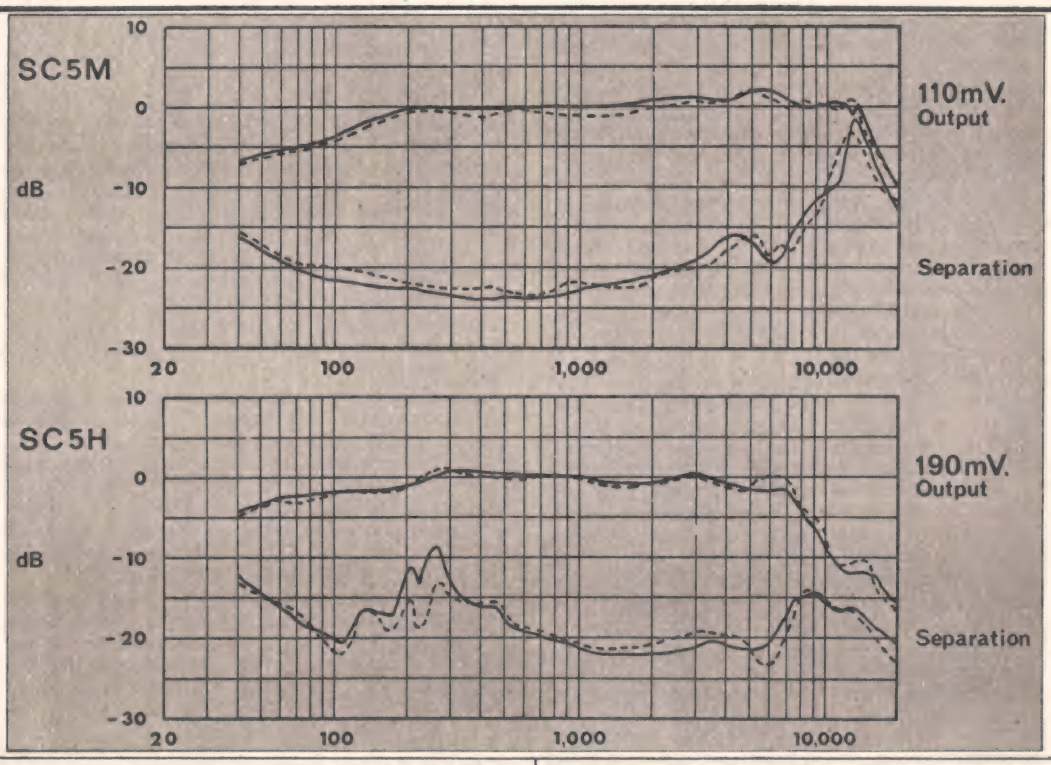
TECHNICAL DATA	SC5M	SC5H
Output at 1 Kc/s. 1.0 cm/sec (using Decca Record SXL 2057)	110 mV ± 2 dB	190 mV ± 2 dB
Horizontal Compliance	6.3 x 10^{-6} cm/dyne ± 20%	1.95 x 10^{-6} cm/dyne ± 20%
Vertical Compliance	3.0 x 10^{-6} cm/dyne ± 20%	1.25 x 10^{-6} cm/dyne ± 20%
Test Temperature	20° C—68° F	20° C—68° F
Recommended Loading	2 M Ω 100 pF	2 M Ω 100 pF
Equivalent Capacity per Channel	1.000 pF (Nominal)	1.000 pF
Channel Separation at 1 Kc/s	Greater than 15 dB	Greater than 15 dB
Channel Difference	Less than 3 dB	Less than 3 dB
Recommended Stylus Pressure	2-6 Grammes	5-7 Grammes
Colour	Graphite Blue	Graphite Blue



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LIGHTING FOR COLOUR

By James G. Boyers (ATV Network Ltd.)

Introduction . . .

Lighting for television has to satisfy two basic needs — the technical demands of the system, and the artistic requirements of the productions. This statement applies to both black-and-white and colour, but in certain areas the lighting requirements for a colour system are much more exacting. There is also far greater scope for the expression of mood or atmosphere with the use of colour. More often than not, a human face forms one of the most important parts of a picture on the screen, whether in black-and-white or colour. Furthermore the face is of a colour which can be regarded as a standard by the viewer of a colour picture — everyone knows what colour a face should be! For this reason, when colour cameras are aligned prior to a production, the final matching is performed using a live model in front of the cameras.

In studio work, particularly light entertainment, the colours of backings, settings, etc., are to a large extent subjective. This may not be applicable in the case of drama where, for example, a natural wooden door must, by and large, have the colour normally associated with wooden doors. This really means that any object, background, or scene, the colour of which may be familiar to a viewer, must be carefully reproduced.

In outside broadcasts the emphasis is on realistic representation of grass, trees, etc., and these too form a recognisable standard for the viewer. However, these programmes more often than not are lit in a manner outside the full control of the Lighting Director and, as such, are outside the scope of this article.

I must, however, mention that the video engineer working on an outside broadcast sometimes has great problems with colour temperature, in view of the fact that within the space of a few minutes the colour temperature of daylight may change from a value of 5000K in direct sunlight to some 10,000K in overcast conditions — a change which cannot be adequately handled without considerable readjustment to the camera parameters. However, more about colour temperature later.

THE BASIC PLOT: A black-and-white picture is made up of variable areas of light and darkness indicating contours and depth in plan of the scene or face. A three-dimensional object (e.g., a face) has height, width, and depth and any lighting set-up should reveal these characteristics. These contours of a face can be reproduced using the basic lighting plot shown in figure 1.

Lamp "AA" provides vertical modelling because it shines down on the subject and will show shadow detail where the subject curves away from the source. Also, because it is shining from a position horizontally displaced from the camera viewing angle, the lamp will also reveal where the subject is curved in the horizontal plane. Thus, one lamp strategically placed provides essential modelling and is termed the modelling light.

Such a lamp is sometimes referred to as the "key lamp," but this is an ambigious term because the "key" of a picture is often the light source which sets the mood of the picture, e.g., sunlight, moonlight. This true "key" light may contribute nothing whatsoever to the shape or expression of the face of a person contained within the scene. For instance, in the case of a contra-jour (against daylight) shot of a person it is quite clear that there is no light available from the key light, e.g., the sun, with which the face can be modelled. The modelling light is usually a "hard" source, being relatively small in area compared wih the subject.

However, to return to the lighting plot, lamp "A" will provide shape to the subject, but the light will fall to nothing around the unlit side of the face, thus creating a condition of excessive contrast. To control this, a lamp known as a "soft" source is usually employed. This is a lamp which, by virtue of being a large area source relative to the subject, does not create secondary shadows of its contours. In figure 1 this lamp is labelled "B."

In the same way that the modelling light is sometimes referred to as the "key" light, this term "soft" source, too, can be misleading. A lamp to perform the function of a fill light, i.e., that of reducing contrast, could be a hard source if it were placed so that it did not add any shadow detail to the modelling achieved by the modelling light. The basic plot would then be as shown in figure 2.

Use of a fill light such as this avoids interference with any other lighting, coloured or otherwise, on the set.

The face has now been lit in such a way that its shape and depth can be discerned but no division has been created between it and any background. To achieve this, one or more lamps are added, shining from above and behind the subject. Such a lamp, "C" in the plot, will create a rim of light around the subject which the camera or eye interprets as a separation between subject and background, and gives an illusion of depth on the screen.

Suitable adjustment of the relative intensities of these three lamps is sufficient to obtain a satisfactory black-and-white picture.

Black-and-white 4½in image orthicon cameras usually require light at a level around 70ft candles, at which they operate satisfactorily with an average lens aperture of f/8-f/11. These cameras are, to a large degree, unaffected by quite large changes in the colour of light used, being sensitive only to the brightness and contrast of a scene, reducing all colours to various tones of grey and reproducing a contrast range (i.e. the ratio of intensities between the brightest and darkest parts of the picture) of some 40:1.

Colour cameras, however, by definition, see objects with the added dimension of colour. This fact introduces far reaching complications in the demands made on the television lighting directors who hitherto, in the U.K. at any rate, have been concerned with colour only in that all colours are reduced to various shades of grey.

COLOUR TEMPERATURE: Apart from the obvious difference that the colours of the scene now have importance in their own right, and are not just a pleasing means of obtaining tonal variations, the colour of the light used to illuminate such scenes assumes a much greater significance. It is essential that the spectral quality of the white lights used is very carefully controlled. This characteristic of light is measured in terms of colour temperature, a most impor-

tant term to anyone lighting a colour production, and one that may need a little explanation.

If a "black body," a theoretical body which is intrinsically non-radiating and non-fusible, is heated, the energy distribution of the light which is then emitted is solely dependent on the temperature to which it is heated: this temperature, expressed in degrees Kelvin (K), is used as a measure of the energy distribution of the light emitted. At low temperatures the energy is concentrated at the red end of the spectrum; as the temperature increases there is a gradual shift of the relative amounts of radiated energy towards the blue end. Incidentally, the term "degrees Kelvin" is derived from a temperature scale using absolute zero, approximately — 273 degrees C, as the zero reference, and named after the man who first showed such a scale to be theoretically sound.

Mention must be made here of lamps which have a discontinuous spectrum, i.e. those which do not contain all the visible colours of the rainbow. These sources of illumination are of little use in colour television except, perhaps, for special effects. For example, a carbon arc radiates most of its energy at the blue end of the visible spectrum and has little or no red content.

Use could be made of such a source to simulate moonlight, as the light is intensely blue and cold. But if a face were to be illuminated with this lamp, it would be very blue indeed. Colour correction (i.e. adjusting the spectral content of source) is not feasible because the light does not contain useful amounts of many of the colours essential to a balanced source and therefore such correction is usually both uneconomic and impractical for colour television. Furthermore it will be obvious from basic colour theory that the use of a lamp, the spectrum of which lacks for example red to illuminate a red object, results in the object appearing black. Therefore for all normal purposes one must use a source with a continuous spectrum and with reasonable amounts of every colour in terms of spectral energy.

Here one must beware of being misled by a colour temperature reading which suggests that the source is suitable for mixing with normal incandescent lighting. The colour temperature reading may be influenced by a hump (or trough) in the unknown source's spectrum which would lead to colour aberrations in the colour picture. So before any source other than incandescent lamps is used on recognisable features or objects, it is advisable to ascertain from its spectral curve the exact nature of the new source — colour temperature alone can be extremely misleading.

Incandescent studio lamps are designed to radiate a continuous spectrum of visible light with a colour temperature of 3200 K when the lamp is supplied with the correct voltage, and film studios operate their lighting at this colour temperature. However, it is possible to line up colour cameras to produce the correct colour response at any particular colour temperature within a fairly wide range.

It has been found advantageous to line up to a rather lower colour temperature, thus allowing the use of dimmers to compensate for the gradual loss of colour temperature which a lamp experiences during its useful life. The change of colour temperature is effected by varying the voltage supplied to the lamp. With 240V tungsten filament lamps, a 15 per cent drop in voltage will reduce the colour temperature by some 150K. The light output will be reduced by approximately 40 per cent, and this permissible variation provides useful flexibility in the studio.

ACCURACY ESSENTIAL: Having established a convenient colour temperature at which to operate, it is then essential accurately to maintain this figure from any lamp which is used to illuminate subjects, the colour of which may be familiar to viewers. This applies particularly to the human face.

If we now refer back to figure 1, lamps "A" and "B" must have their colour temperature, as well as their intensity, carefully controlled. Should the colour temperature of these lamps vary by more than about 200K, relative to that at which the colour cameras were aligned, noticeable and objectionable colour changes take place in the flesh tones. A lower colour temperature results in reddening of these tones, while a higher one will cause the face to assume a blue tint. Either of these effects will be recognised by the viewer as an aberration.

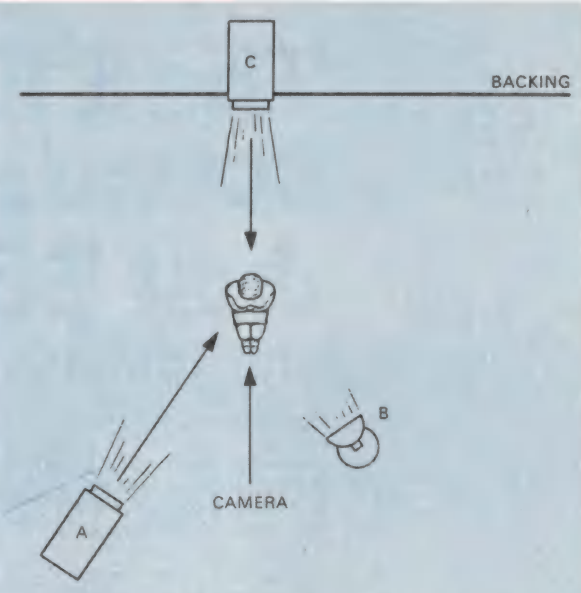

Figure 1a: A plan view of the basic lighting plot for reproducing a face. Though the article refers specifically to lighting for television, the principles apply equally for ordinary photographic situations.

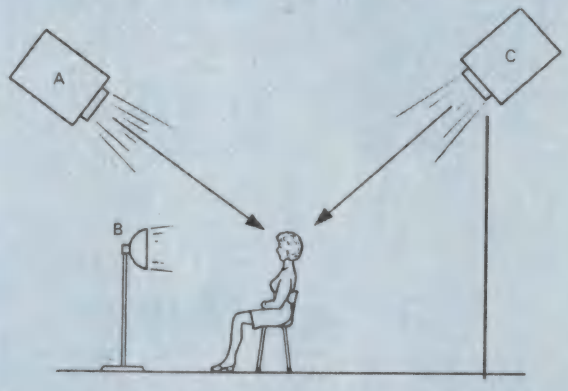

Figure 1b: A side elevation of the basic lighting plot shown above. Actual photographs taken under these lighting conditions are reproduced overleaf.

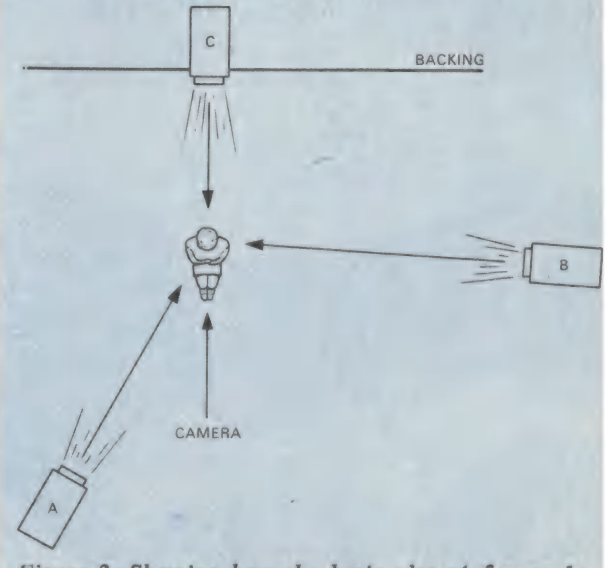

Figure 2: Showing how the basic plot of figures 1a and 1b can be modified to use a hard source for the fill light.

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Figure 3, above: A model lit only by a modelling light. Note the deep shadows.

Figure 4, top right: The model with both modelling and fill light. Shadows are relieved but some areas of the face are very flat.

Figure 5, below: The model lit according to the basic lighting plot. The shadows are soft and the facial contours excellent.

The back or rim light "C" is far less critical regarding colour temperature. A variation from nominal of 1000K will not produce objectionable changes.

This then is the real difference between lighting for colour and lighting for black-and-white. In colour, the spectral quality of an illuminator is all important, should one wish faithfully to present an object the colour of which is familiar to viewers.

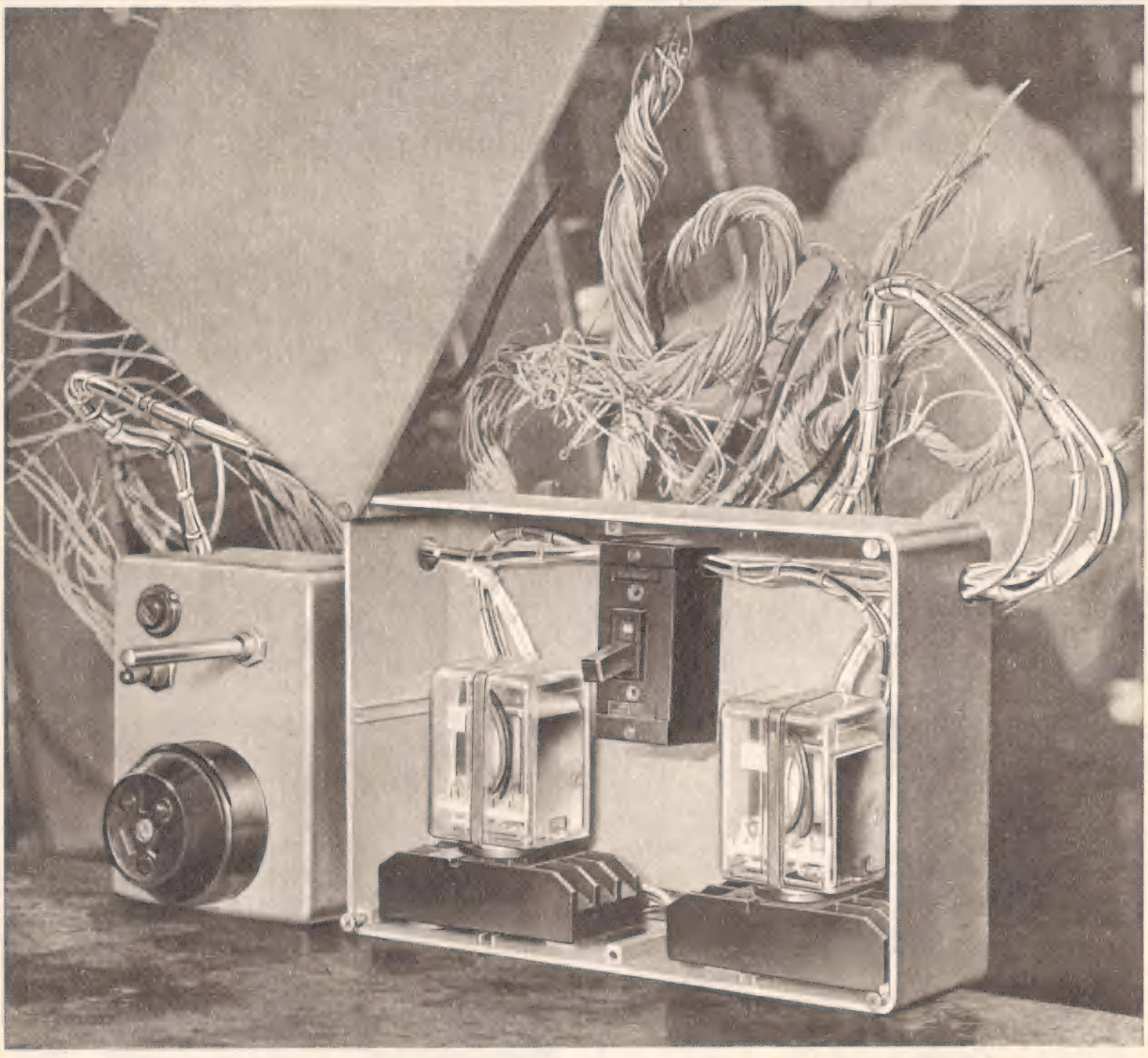
Such control is not necessary for the illumination of subjects the intrinsic colours of which are unknown to the viewer — for example, decorative backgrounds — so long as the finished result on the display tube is the desired one from the aesthetic point of view.

VARYING INTERPRETATIONS: The intensities of lighting for the colour camera is a subject of a variable interpretation by different groups of people. In view of such wide limits, various productions at ATV were lit to different levels, starting at the highest figure which had been quoted for colour cameras fitted with Plumbicon type tubes — 350ft candles. This turned out to be a much higher level of light than was necessary. As it is advantageous for many reasons to adopt as low a level of light as is practicable, the intensity was reduced until a level of 150ft candles was found to be adequate.

In Plumbicon cameras the iris and gain controls have a similar effect inasmuch as operation of either varies the signal output from the camera. Increasing the output by turning up the gain control, however, increases the electronic noise in the resulting picture, whereas increasing the light falling on the tube does not. Thus the light level used is determined by a compromise between acceptable noise on the picture and an acceptable lens aperture. At a level of 150ft candles the Marconi Mk VIIB camera operates at about f/8 (image orthicon format) which gives adequate depth of field, and provides enough latitude for vision control purposes.

MODIFIED RELATIONSHIPS: Turning to the actual production lighting, the advent of colour television will effect profound changes upon both the scope of a lighting director's contribution to a program and the relationship between the producer, lighting director and designer.

The lighting of a production in black-and-white has to convey every mood of a drama and every variety of a light entertainment setting, solely by the manipulation of light and shade. The use of colour, as well as light and shade, immediately enables us to intensify the impact, pleasure, or emotion evoked by a production, a fact well known and



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used by the film industry, but out of our reach until now. However, to achieve a satisfactory result much closer attention has to be paid to detail and the planning has to be more precise.

For example, if a lamp is placed to cover a given field at a certain intensity and colour temperature, subsequent alteration to the plane of this field cannot necessarily be compensated by use of the associated dimmer, as could well be the case in black-and-white lighting. Such compensation would cause a change in colour temperature which might well be unacceptable. The only course would be to move or change the lamp in question, an exercise that could be very complicated in a fully rigged production and one which would almost certainly take a considerable time — time which could be ill-afforded in a competitive television production company. Hence to avoid this, the action and the lamp position must be accurately planned beforehand.

Another facet of preplanning, which affects black-and-white productions only in a broad tonal sense, is the choice of colour for backgrounds, whether for drama or for light entertainment. It would, for example, be disastrous to provide a coloured background for an artist, only to find that she has arrived with only one dress which clashes with the background in a totally unacceptable manner. It is not possible, as with a black-and-white production, to adjust the level of light on the offending background in order to achieve the necessary separation between backing and artist.

The remedy in a colour show has to be much more drastic and time consuming, possibly involving painters or a different set of colours in the lamps illuminating the background. This example points again to the necessity of tightening up all planning and co-ordination between departments engaged in mounting a colour production, if first-class pictures are to be produced.

COMPATIBILITY: There is yet another complication which should be mentioned, as it may affect the majority of viewers in the early days of colour transmissions. I refer to those who will view the pictures on an ordinary black-and-white receiver. Such a picture is called the compatible version of the original colour transmission. The colour pictures are transmitted in such a manner that they can be received, interpreted and displayed on a normal black-and-white receiver, but, of course, only as a picture composed of shades of grey corresponding to the luminances of the colours of the original picture. For example, a saturated colour will be displayed as a fairly dark grey and an unsaturated colour will appear as a much lighter tone of grey.

Complications arise because different colours with the same luminance will be displayed as exactly the same shade of grey in the compatible picture. Thus two parts of a picture may appear as quite separate colours in colour, but when received on a black-and-white set appear as one. A particular pitfall is the credit caption. If sufficient care is exercised in the choice of lettering and background the caption may be almost invisible in black and white while being perfectly legible in colour.

Altogether the added dimension of colour presents to all technicians and artists working within the medium, exciting and exacting challenges, a few of which I have attempted to outline. I hope that the viewers will find the results as exciting.

ACKNOWLEDGMENT: The foregoing article appeared in "Sound and Vision Broadcasting," winter 1969, volume 10, number 3. It is reproduced by arrangement with Marconi Communications Systems Ltd., Chelmsford, England.

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NOTES AND ERRATA

IMPROVED BURGLAR ALARM (Reader Built It, March, 1970, p105): Some readers have reported that with particular specimens of T1 (2N649, AC127, etc.) Iceo is of such a value that under low ambient temperature conditions (i.e., during the winter months) it drops to a point where it will not provide sufficient forward bias to allow T2 to pull in the relay. In such cases the following modification is suggested. A small amount of forward bias is provided for T1 by connecting a 1M resistor from collector to base. A protection against thermal runaway is then provided by connecting a 470 ohm resistor in series with the lead from T1 emitter to T2 base.

SOLID STATE FREMODYNE (May, 1970). TAA 300 IC on p51, "viewed from above" should read "viewed from below." Audio board on p61 is correct. Fig. 4, p59, bottom left lugs 1 and 2 should not be connected. Tuning capacitor goes to lug 2.

ADDING AN S-METER (February, 1970). In describing the operation of figure 2 at switch on, the meter is subject to a forward voltage and not a reverse voltage as stated in the text.

1970 ALL-WAVE TWO (April, 1970). TAA 300 IC on p45, "viewed from above" should read "viewed from below." Audio board on p49 is correct. Right-hand diagram, p49, should show 0.1uF across 100uF, with neg. side earthed.

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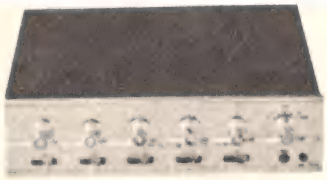

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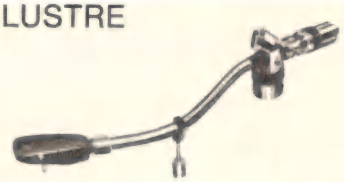

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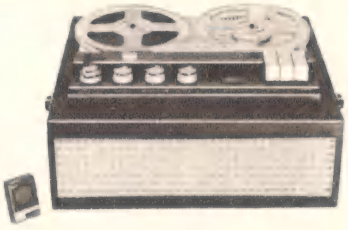

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THE SERVICEMAN

Simple faults — complex results

On more than one previous occasion I have made the point that faults which are quite trivial — in the electronic sense — can have a positively devastating effect on the performance of a piece of electronic equipment. The story which follows is a choice example; involving, as it did, the unnecessary sacrifice of two perfectly good amplifiers at bargain prices.

Some people can get themselves into a lot of strife, without even trying, when they start playing around with audio equipment. My opinion nowadays is that people who do not understand some of the technicalities involved would be better advised to stick to one or other of the better quality commercially built jobs which are now available at fairly competitive prices. No mucking about then, just plug it in and away she goes. Needless to say, this philosophising is leading up to a story: The Tale of Two Amplifiers. In the first instance a certain party let himself in for some unnecessary expenditure, then somebody else found himself with two faulty units of the same make on his hands on the same evening.

Anyway, to get on with the story. . . . It began when I had occasion to visit a friend who, although not in the servicing business, is a keen electronics hobbyist, has an amateur licence, and is well versed in audio circuitry. He commutes daily to the city and comes into contact with the same group of fellow travellers every day. And, having learned of his interest and skill in matters electronic, they frequently seek his advice about their radios, TV sets, audio amplifiers, etc.

The story began when one of the travelling companions experienced trouble with his record playing equipment. The equipment was, in fact, a commercial version of the Playmaster 106 Tuner/Amplifier described in this magazine some years back. The unit had apparently worked well for some time, but was now giving trouble. The fault was intermittent and consisted of a noise which, from the description supplied, my friend diagnosed as motor boating. He advised his friend to call in a competent serviceman, and commented that the trouble would probably be found in the filter circuits.

A few weeks later the matter was raised again. It appeared that a serviceman from a local radio store had called, examined the unit, replaced a valve, and gone on his way pronouncing the set in perfect working order. Unfortunately the fault persisted. Because of its intermittent nature (and following the well known Edsel Murphy's Law) it had not shown up during the examination by the serviceman. Not only was the fault not cured, but the set now had another intermittent fault — occasionally it ceased to play in one channel.

Well, to cut a long story short, my friend gave what advice he could — change over the leads from the turntable, get the cartridge checked, switch the loudspeaker leads, and so on, to try to establish the section responsible for the second fault. He even made up a replacement pair of audio leads to substitute for those from the pick-up to the amplifier — but all to no avail. One day, the disgruntled passenger announced that he had ordered a replacement amplifier from the same place that he acquired the original unit — a company with good standing in the field, incidentally—as he was convinced that the old unit had "had it."

"Son, run see if daddy's got the TV set fixed yet," ("PF Reporter").

As it was virtually a new unit this seemed, to my friend, to be a most unreasonable assumption. However, as the other chap had already made up his mind, there was little my friend could do about it.

At that stage, he would perhaps have been justified in thinking that he had heard the last of the old system. Far from it. A few days later the stream of complaints began again. The new amplifier had duly arrived and had been fitted by his "brother-in-law," who apparently fancied he knew a bit about this electronics business. He was in fact employed in a valve factory, and this was apparently sufficient to secure for him an aura of knowledge. Unfortunately, while the motor-boating had vanished, as one would expect, the intermittent channel fault still persisted. The loudspeakers and turntable had apparently been tried with other units, and had apparently performed satisfactorily, so, it was reasoned, the fault must lie in the amplifier. Twice the amplifier went back to the constructors, twice it was returned as performing fully to specification. What to do?

Apparently the owner was a person with little patience with faulty equipment. Shortly after this he announced that he was going to buy a commercially built stereogram. What was he going to do with the equipment he had? "Sell you the lot for $200," he announced.

My friend did not have to reflect for long to see that here was a first rate bargain. Two amplifiers with tuners, a transcription turntable, good quality loudspeakers and a professionally built cabinet for $200 was not to be missed. He bought it.

At home, it took him little more than half an hour to get both units working satisfactorily. The reason why the new unit was not performing satisfactorily was because the cartridge leads in the head shell were in a disgraceful condition. One wire had separated entirely, and was just resting against its terminal. No wonder the channel was intermittent. Five minutes with a soldering iron, and the unit was playing happily on both channels, delivering sound of excellent quality.

As a matter of routine, he turned the cabinet over to reveal the innards of the amplifier, and was impressed with what he saw. The amplifier had been most carefully built and had a very professional look. Satisfied, he turned his attention to the older unit.

It was immediately obvious that this unit was not so neat. While perhaps adequately built, it lacked the clean layout and professional finish of the later unit. Which seemed to indicate that the firm concerned was improving its standards. A pair of loudspeakers was connected and the unit switched on. The gremlins responsible for the efficient operation of Murphy's law seemed to be taking a holiday that day, for the motor-boating immediately became apparent.

Before attempting anything in the way of voltage measurements and component checks my friend had a preliminary poke around to see if there were any visual clues; which is always a good idea. And in almost no time at all he found one. A chassis lead from an electrolytic terminated on a lug held under the nut of one of the power transformer mounting bolts. Unfortunately, the nut had not been tightened properly and the lug was floating; sometimes it made connection, sometimes it didn't. Tightening the nut

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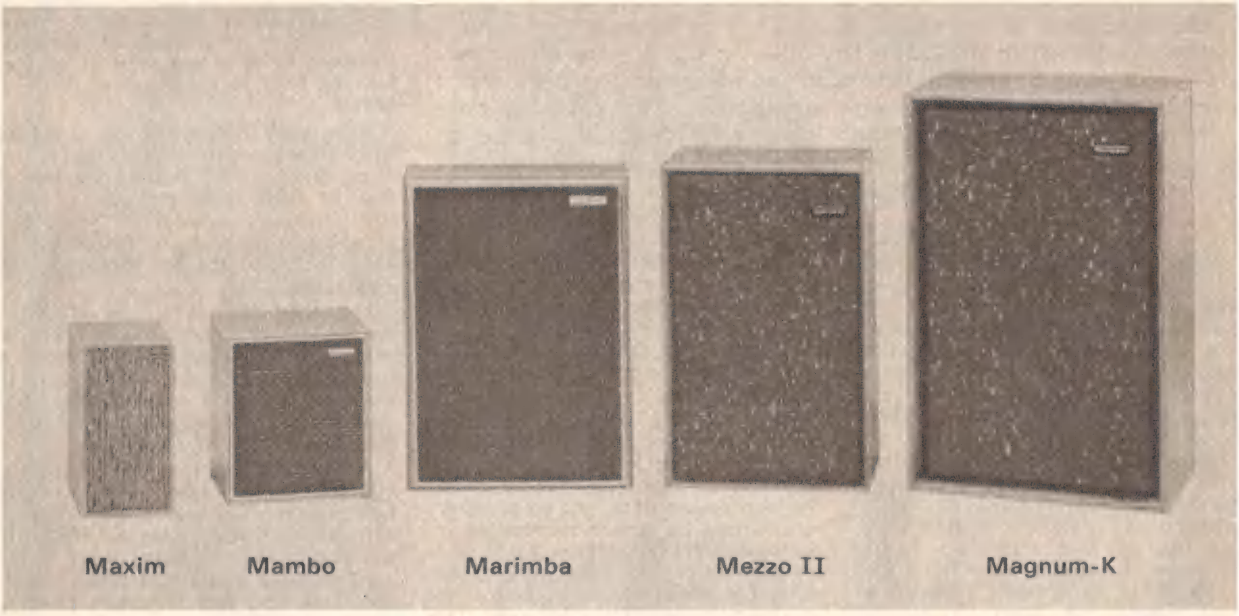
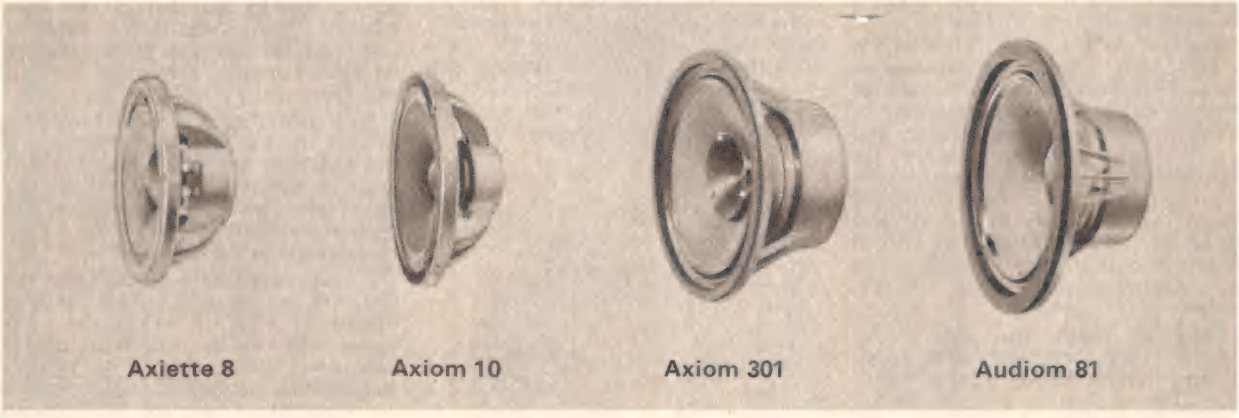


Maxim Mambo Marimba Mezzo II Magnum-K



Axiette 8 Axiom 10 Axiom 301 Audiom 81

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cured the motorboating — and it has never recurred. But how a serviceman could inspect the unit, as he supposedly did, and miss such an obvious fault is beyond me. Still, as my friend said, there are servicemen and servicemen.

Although my friend had originally intended to keep the entire system he had acquired, it so happened that he already had two perfectly good loudspeaker systems and a good quality turntable. So, with the spare amplifier, he was able to set up a second complete system. It is perhaps not surprising, therefore, that when, a few weeks later, a friend indicated a desire to obtain a record player, a bargain was soon struck and the newer system changed hands once again. My friend retained the older of the two amplifiers for his own use.

For a few months after this, everything went along happily. The new owner was delighted with his system, while the older unit now worked entirely adequately. Then it happened.

The first intimation that something was wrong came when the new owner of the equipment complained, over the phone, that the unit was "howling." Suspecting a valve fault, my friend advised changing the 6GW8 output valves around. Shortly afterwards, the owner rang back to say that the fault had cleared when the valves were put in the opposite channels. Although this seemed to satisfy the owner, my friend was not so optimistic. The next evening he had been invited to a record playing session at the home of the owner, so he armed himself with a pair of 6GW8s he happened to have around before setting out. Just as well he did. When he arrived, he found the owner in a state of mild panic. According to him, both 6GW8s in one channel had "blown up."

Thinking that the trouble could have been caused by an internal short in the valve, particularly as the owner mentioned some "sparking" inside the valve, my friend produced the two replacement valves he had brought with him and inserted them in place of the missing ones. Then with the set switched on, a disc was placed on the turntable, and soon the unit was playing happily — or was it? There was music coming out of both loudspeakers to be sure, but one channel sounded queer, with a muffled quality. A glance round the back of the set was sufficient to send my friend racing for the power switch — the anode of at least one of the new 6GW8s was glowing like a toaster element. He didn't wait to check the other one, which was partly obscured anyway.

Since the idea had been to listen to records, and several other people were sitting around expectantly, it was obviously not an opportune time to start pulling the unit down to look for the cause of the trouble. So my friend offered to go for his own amplifier to act as substitute for the evening. Being the unit which had originally come out of the cabinet, no trouble was expected in connecting it up to the system. So he hopped into his car and dashed off home to get it.

Unfortunately, the gremlins were working overtime that evening, or so my friend thought when, having arrived back with the amplifier, and having connected it into the system he found to his consternation that smoke issued forth from the innards shortly after it was switched on. A quick check showed that he had not done anything silly, so it appeared like another servicing job. At this stage it was decided to abandon the idea of a record evening and to play cards instead.

It was a couple of days after this that my friend contacted me. He knew my interest in servicing stories, and the value of unusual ones for these notes. Accordingly he invited me to call in to see him when I had a moment. The following day, finding I had some time to spare, I called in to his home to find him sitting in his workshop with two amplifiers before him. And, having related the story I have just told, he showed me what he had found.

It had not taken him long to pinpoint the trouble in each case, but he had held off fixing them so that I could see the faults "in situ." It was soon obvious why the 6GW8s had overheated. The cathode bypass capacitor had spilled its inside outside—in other words, it had burst and, in the process, had short-circuited, effectively removing the bias normally developed across the cathode resistor.

It was soon obvious why this had happened. The two components were in direct physical contact. The sequence of events appeared to have gone like this. Firstly, the heat from the resistor had melted the plastic sleeve of the capacitor. Subsequent heating had caused the capacitor to build up an internal pressure, which had forced out the end plug. The capacitor had then developed an internal short effectively removing the bias from the valve. In these circumstances it is not at all surprising that the valve had become very red in the face. With replacement components to hand, only a few minutes work with a soldering iron was required to put the unit back into working order.

Now to the second unit. Here too, the trouble was not difficult to find. With a small screwdriver my friend indicated a lead which had come away from one of the filter capacitors. It was a clear example of a hidden dry joint. On the surface, the solder appeared to be in a satisfactory shiny condition, internally it was crystalline and brittle. What had apparently happened was that in transporting the amplifier in a car, the faulty joint had come under strain and had given up the ghost.

The lead which had become detached was at the junction of the filter choke and the second filter capacitor. As a result the only part of the set receiving HT was the tuner, and the component which had overheated was a 2K 3W decoupling resistor in the tuner HT supply line. Presumably the reduced load on the power supply had resulted in a significant increase in voltage. This could well have caused increased leakage in the 32uF decoupling electrolytic and would certainly have caused increased current drain in the tuner. The total increase was more than the resistor could take.

Fairly obviously, none of these faults had anything to do with the design of the amplifier. They were due entirely to poor workmanship; careless soldering in one case and careless component arrangement in the other. The fact that both amplifiers had come from the

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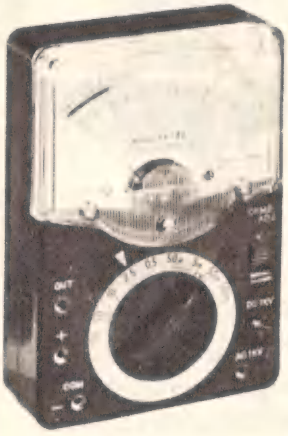

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Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

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Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

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AC Volts: 6, 30, 120, 300, 1200V (10,000 Ω/V)

DC Current: 12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.

Resistance: 20KΩ, 200KΩ, 2MΩ, 20MΩ

Decibels: —20 to + 17, 31, 43, 51, 63.

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Decibels, —20db = +62db .7K/c.
Capacitance, .0001, .01, .0025, .25 mfd.

Model RH-20 $13.95. Postage 50c

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10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

Model RH-55 $20.00 Postage 50c

30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

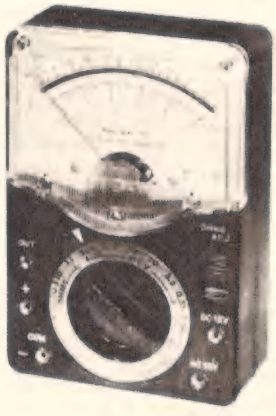
*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

Model RH-60 $25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

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same manufacturer was unfortunate, since I happen to know that they have sold many hundreds of this particular unit with negligible trouble, and have a high reputation in this field. Nevertheless, incidents like these are a sobering reminder that a little carelessness can cause a lot of bad will. When a customer buys what he regards as a "bomb" it is cold comfort to be told that this hasn't happened to 999 other blokes!

To change the subject, the matter of safety and the power mains has cropped up again. This is partly due to the story published in the April issue, and which prompted the letter below, and partly by reports in the Press that there had been an increase in fatal accidents during the past year, compared with the previous year.

First, the letter:

"With reference to your Serviceman article in the April 'E.A.' regarding incorrect connection of 50Hz general purpose outlets. Being an electrician and caravan owner I have had quite a few instances of this problem which is at its most critical in caravan parks where there is a multitude of outlets and extension leads.

"For instance, the puzzled housewife who came over to our van complaining that her electric kettle 'would not switch off.' Thinking it would be a switch welded closed I investigated only to find by means of test lamp that the switch was operating normally. So out came the multimeter. This revealed (1) Reversed active/neutral polarity, eventually traced to the local county council wired G.P.O. (General Purpose Outlet). (2) The switch in the van's power point was a single pole type and not a double pole type as required by S.A.A. regulations. (3) The kettle element had gone to frame near the end connected to what was now the neutral line, effectively by-passing the single pole switch in the neutral line.

"Polarity reversals of this kind — particularly when combined with errors elsewhere in the system — can and have been lethal. There was the case of a van owner who plugged his van into a supply in a van park up north and livened the whole frame of the van, electrocuting his son who was attempting to lower the rear stabilising legs of the van. This was a large-scale example of the case of the live amplifier described in your article, only this one was fatal.

"My own van is fitted with several devices to detect errors of this kind. Firstly, supply to the van is controlled by a Heinmann double pole circuit breaker which also serves as an isolating switch. Secondly, a neon indicator connected between active and earth indicates when power is connected to the van. This is handy in the case of power supply failure. Thirdly, a 250V 15W pilot lamp, connected between neutral and earth lights only if the polarity is reversed at the van park outlet. I always carry a short extension lead with the active and neutral leads reversed. This restores correct polarity in the van.

"The sooner some pressure is brought to bear on the supply authority to set a firm standard for general purpose outlet wiring the sooner these problems are going to be settled once and for all."

T.G., Canterbury, N.S.W.

This letter is particularly interesting in that power in caravans is something which many of us may have thought little about. Yet 240V is just as lethal in a caravan as anywhere else, while there seems little doubt that the very flexibility of a caravan, and which makes it so attractive, is, in itself, a hazard. Inevitably it will be used in a variety of power supply situations and, unless these are carefully standardised and rigidly controlled, they present a hazard in themselves.

But the van itself is no less a hazard. Unless its installation is just as carefully standardised, and just as rigidly controlled, it, too, represents a hazard. And when both the van and the power supply into which it is plugged are wrong an extremely dangerous situation can exist.

And while we are about it, there is one question which I would like to ask. Is there any logical reason why the metal frame of a caravan should be included in the earthing system of its electrical wiring? To me, such a connection, if deliberately arranged, would

(Continued on page 189)

CHARACTERISTICS OF RF CABLES

At one time or another, most amateurs have found themselves with a length of coaxial or other radio frequency transmission cable, without being too sure about its characterisic impedance, its velocity factor and its suitability for a particular application. The chart overleaf, reproduced with the co-operation of Telcon Australia Pty. Ltd. should help solve many such problems.

The uncertainty about cable characteristics can arise in a number of ways.

Sometimes, it concerns odd lengths of cable which amateurs have collected over the years and which they may want to press into service.

It may possibly arise from situations which are reminiscent of the classical story concerning the disposals dealer who could supply any required length of either 50 or 70-ohm coaxial cable — all from the one drum!

In fact, even from more regular outlets, there is sometimes an element of doubt about the identity of a particular piece of cable being offered.

Considering the spread of years, and of sources, there is not much hope of listing and identifying in a compact table all the cables which may have come into readers' hands. For this reason, we have not included any information on shielded cables which are primarily intended for audio work or for short runs of shielded wiring under a chassis.

By and large, cables intended for these purposes are designed to withstand constant flexing and/or rough handling. The conductor usually resembles ordinary hook-up wire and the insulation between the inner conductor and braid is relatively thin (and often black in colour).

RF cables may have either a stranded or solid centre conductor. The insulation around it is usually of low-loss clear plastic and of quite large diameter relative to the inner conductor. The reason for this is electrical, rather than mechanical, and has to do with the fact that RF transmission cables are invariably designed to exhibit a certain characteristic impedance.

To put it into a very small "nutshell," the characteristic impedance of a radio frequency transmission cable is that impedance which it would present as a load, if energy were fed into an infiniate length of that cable.

The condition can be simulated by using a finite length of the cable and connecting across its remote end a non-reactive resistor or load, equal to the characteristic impedance, and able to dissipate the amount of power fed into the cable. The cable/load combination will absorb the power fed into it and will appear as a purely resistive (i.e. non-reactive) load.

In the practical application of RF transmission cables, close attention is normally paid to source, cable and load impedance, sometimes with a view to achieving a close match, and sometimes a carefully worked-out mismatch.

The characteristic impedance of an RF transmission cable is determined mainly by the diameter of the conductors, the spacing between them and the nature of the intervening dielectric. It is, in fact, a matter of the relative inductance and capacitance per unit length.

By noting or measuring the centre conductor, and similarly the layer of insulation around it, most cables likely to be in the hands of Australian experimenters can be identified from the table overleaf. In some cases, nothing more than a finely graduated steel rule will be required but, in others, a micrometer will be invaluable.

Say, for example, that a length of cable is on hand having an overall diameter very close to 0.2 inch. The table shows four cables having this approximate dimension ("Nom. Dia. Over Sheath"). If the centre conductor turned out to be 19 strands of fine wire, it would probably be 19/.0068, as for cable type 75TJ1/01. This figure, and others, could be verified to put the matter beyond doubt if a micrometer was to hand.

If the conductor was a single strand, a micrometer would certainly be desirable to identify whether it was 1/.032 or 1/.022. The first figure would indicate one of two cables which seem almost identical, or 75M1/0U, better known by its alternative type number PT1M. Once having identified the cable, other characteristics such as velocity factor, attenuation, power handling capacity etc., could be read off.

CHARACTERISTICS OF POPULAR RADI(

Current Type Numbers	Equivalent Type Numbers	Description	Nom. Imp. ohms	Nom. Cap. pF/ft	Conductor	Nom. Dia. Over Insulation	Nom. Dia. Over Sheath	1MHz	10MH
75AP1/01	PT98M, RG17A/U, UR74, RG218/U	Coaxial	50	30.7	1/.188	.68	.87		
75PX1/05	PT81M, PT93M	Coaxial	52	29.5	7/.029	.285	.405	0.19	0.6
75PX1/06	UR67, RG8A/U RG213/U	Coaxial	52	30	7/.029	.285	.405		
75S1/01	PT45M	Coaxial	52	29	1/.032	.116	.2	0.23	1.00
75S1/04	UR43	Coaxial	52	29	1/.032	.116	.2		
75TJ1/01	UR76, RG58A/U RG58C/U	Coaxial	50	30.5	19/.0068	.116	.195		
75PK1/19	PT9M	Coaxial	55	29	7/.0076	.085	.165	0.70	2.00
75PZ1/01	PT20M	Coaxial	71	22	7/.048	.8	1.0	0.08	0.27
75PZ1/02	UR17	Coaxial	71	22	7/.048	.8	1.0		
75X1/04	PT29M	Coaxial	71	22	1/.056	.33	.45	0.15	0.49
75X1/01	UR1	Coaxial	71	22	1/.056	.33	.45		
75M1/04	PT1M	Coaxial	71	22	1/.022	.128	.205	0.35	1.12
75M1/05	UR32	Coaxial	71	22	1/.022	.128	.23		
75PK1/05	PT77M	Coaxial	71	22	7/.0076	.128	.23	0.40	1.28
75PK1/16	UR70	Coaxial	72	21	7/.0076	.128	.23		
75V1/06	PT91M	Coaxial	75	20.6	1/.044	.285	.405	0.18	0.58
75V1/08	UR57, RG11A/U	Coaxial	75	20.6	1/.044	.285	.405		
75PK1/17	PT11M	Coaxial	73	22	14/.0076	.2	.31	0.24	0.77
75PK1/09	PT11MYM	Coaxial (double screened)	73	20	14/.0076	.2	.41	0.31	
75RK1/02	AS91M	Coaxial (air spaced)	110	11.5	3/.0076	.15	.224	0.85	2.70
75FG1/01	ASA200M	Coaxial (air spaced)	145	8	1/.0124	.2	.295		
75V1/03	ET10M	Coaxial (cell. poly.)	75	17	1/.044	.2	.29		0.60
75X1/05	ET13M	Coaxial (cell. poly.)	75	16.4	1/.056	.25	.37		
75PK1/15	ET6M	Coaxial (cell. poly.)	75	17	7/.0076	.093	.16		1.5
	K20	Flat oval twin	75	21	1/.036En		.16 x .10	0.4	1.1
	K24	Flat twin (fig. 8)	150	9.5	7/.012		.18 x .09	0.22	0.72
	K25	Flat twin	300	4.0	7/.012		.405 x .09	0.14	0.43
74PN2/04	KA45	Flat twin	285		7/.012		.375 x .066		
74PM2/10	KA47	Flat twin	300		7/.010		.395 x .07		

FREQUENCY TRANSMISSION CABLES

Attenuation dB/100ft				Max. Power Rating In Air (KW)			Nom. Vel. Ratio	Max. Operating Volts KV Peak			Approx. Weight lb/100yd
100MHz	200MHz	600MHz	1GHz	1MHz	10MHz	100MHz		Pulse	RF	DC	
0.97	1.47	2.96	4.20			1.40	.66	30.0	15.0	120.0	131
2.00	2.94	5.52	7.45	6.26	1.95	0.58	.66		4.8		32
2.00	2.94	5.52				0.54	.66	9.6	4.8	38.4	32
	7.21										9
4.33	6.87	13.70				0.16	.67	5.25	2.75	21.0	9
	9.3								1.90		9
7.10	8.7		22.00	0.50	0.20	0.05			1.00		6
0.95	1.78		4.12	19.50	5.85	1.64			11.40		145
1.07	1.69	3.83				1.56		21.00	10.50	84.0	145
1.65	2.78		6.33	6.43	2.02	0.60			6.20		35
1.74	2.65	5.67				0.64	.66	12.50	6.25	50.0	35
3.65	6.14		12.67	1.95	0.65	0.19			2.4		8
3.94	5.85	11.86				0.17	.66	5.00	2.50		12
4.15	7.21		14.25	1.73	0.53	0.17			1.8		10
4.65	6.87	13.42				0.15	.66	3.60	1.80	14.4	10
1.95	2.91		7.27	5.41	1.69	0.51			5.10		29
1.89	2.77	5.23				0.58	.66	10.50	5.00	42.0	29
2.53	4.4		9.12	2.94	0.92	0.28			2.70		17
	4.4										24
8.50							.80				9
	6.00						.84				9
2.20	3.30										13
	2.20										23
4.8	7.2										6
5.1	8.0			2.0	0.6	0.2					4
2.5				3.1	1.0	0.3					3
1.4				5.2	1.7	0.5					4
1.2											6
											5

A READER BUILT IT

Adding blinkers to a trailer

A description of how to add an extra set of blinker lights, as used on a trailer, to an existing car blinker system.

Here is a circuit I have used to add blinkers to a car trailer. Whether this system saves on the trade item would depend on the parts the constructor has on hand.

The requirements of any trailer blinker system may be summarised as:

1. An indicating light in the car that flashes with the trailer lights and will not operate if the plug or globe are open circuit.

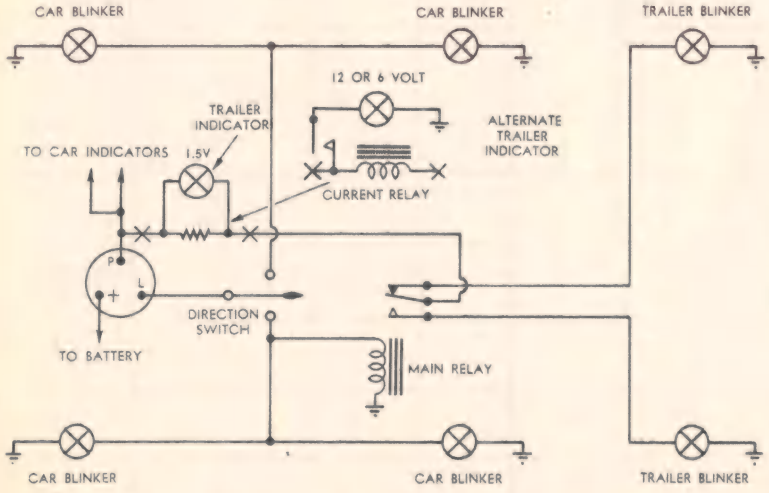
2. Connecting the trailer should not alter the flashing rate or render the car indicators unable to show a faulty globe. This objection does occur if the trailer lamps are simply connected in parallel with the car lamps.

Requirements (1) may be satisfied by fitting either a current relay in series with the trailer lamp, or by using the voltage developed across a series resistor to light a 1.5 volt indicator lamp. Use of a relay allows either a 6 volt or 12 volt indicator lamp to be used and is equally suitable for either 6 volt or 12 volt systems. The series resistor system reduces the voltage to, and therefore the brilliance of, the trailer lamps by the 1.5 volts needed to operate the indicator lamp. This is not a serious loss with a 12 volt system, but usually cannot be tolerated with a 6 volt system.

Requirement (2) was satisfied by operating the trailer lamps from the pilot light terminal of the flasher. This works in unison with the main blinker contacts, but the pulses still have to be directed to the right or left in accordance with the direction switch setting. This would be most easily achieved if the direction switch had an extra set of contacts, but this is seldom the case. The alternative is to use a relay with a set of changeover contacts, directing the signals to (say) the right when the relay is not energised and to the left when it is energised. The relay coil is then wired to be energised by the left contact on the direction switch.

SPECIAL REPRINT

Of all the ideas published on these pages, those with an automotive flavour appear to have aroused most interest. To assist readers interested in these projects we have selected a representative group and reprinted them on this and the following pages. The result is a most useful collection of projects, all in one issue for handy reference.



This relay can be an ex-P.M.G. type suitable for voltage of the system. A 1,000 ohm (or smaller) coil should suit a 12 volt system, or a 500 ohm (or smaller) a 6 volt system. It should have a set of changeover contacts, or a set of normally open and normally closed contacts which can be wired into this configuration.

If a current relay is to be used to operate the indicator light it can be a conventional relay or, as I used, a dry reed switch. In either case the coil will need to be of only a few turns of heavy gauge wire. The turns needed are determined from the ampere/turns required to operate the relay (refer reed switch data sheets) divided by the current taken by one trailer lamp.

If a series resistor is used to operate the indicator lamp it can be made from a short length of resistance wire wound on a higher value resistor or an insulated rod. Turns should be spaced and held with glue, tape, or epoxy. The wire may be salvaged from an old heating element. The value of the resistor should be such as to develop 1.5V when the current for one blinker (at 10.5V) flows through it.

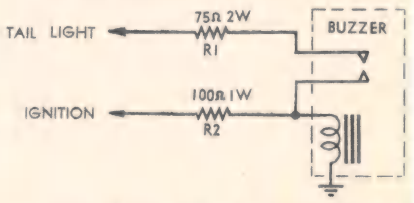
(Submitted by: Mr I. Robertson. Originally published: November, 1968.)

"Lights on" warning

A circuit for a simple warning buzzer intended to guard against car lights being left on when a car is parked. The circuit is commendably simple, and may find application in other situations.

As my dash ights are not obvious in daylight, I have twice inadvertantly left the lights on after parking and have been greeted by a flat battery on my return later.

I was prompted to devise a gadget which would warn me if the lights were left on after the ignition was switched off. I decided on a buzzer for the signal, as a light might not be noticed on a bright day.



The supply for the buzzer (a "Federal" 12V door buzzer, 25 ohm coil) was taken from the tail light contact on the light switch. This contact is activated in both the "park" and "headlight" positions. A resistor (R1) was connected in series with the buzzer to reduce the loudness, as it was found

(Continued opposite)

Car burglar alarm system

Those who have had the unpleasant experience of their car being broken into and rifled in their absence will appreciate this idea for a car burglar alarm. Operated by the automatic door light switch, it causes the horn to sound a few seconds after an illegal entry has been made into the vehicle.

When set, the car burglar alarm sounds the horn for a pre-determined time when either front door is opened. The on/off switch is inside the car, so the unit has built-in delays for entering and leaving without operating the alarm. To leave the car without triggering the unit a delay occurs after S1 is closed. The delay results from the time taken for C2 to reach Z1 breakdown voltage when charged through R5. With C2 charged, opening the door will cause TR1 and TR2 to conduct, with almost 12 volts appearing across R3. At the same time. C1 is charged and will hold TR1 on after the door is closed.

To allow the car to be entered with time to switch off the unit before it operates, the voltage across R3 feeds the delay (R7, C4 and Z2) at TR4. If the unit is not switched off TR4 conducts, picking up the relay, and the horn sounds. The horn will continue to sound until C1 discharges, causing TR1 to reduce the potential across R3 until it drops below that required for Z2 to hold TR4 in the conducting state.

The sequence detailed above occurs if the door is left open quickly after the illegal entry has occurred. However, if the door is left open, C1 would not discharge, and the horn would then operate continuously, until the car's battery was flattened. To prevent this, an additional transistor (TR3) has been added. This has a delay circuit similar to that of TR2 and TR4. When triggered, and the door is left open, it discharges C2. which cuts off TR2 and opens the supply to TR4, thus stopping the horn.

For a more detailed system, further switches may be added, as shown in the circuit. These could be at any point where thieves could gain entry (back doors, bonnet and boot, for example). When connected as shown they will not operate the roof light.

NOTES:

D4 protects TR4 by providing a path for the back EMF generated when the relay operates.

The relay contacts are in parallel to distribute the large current drawn by the horn, and thereby contributing to longer contact life.

The horn relay contacts and earth contacts should be heavy gauge wire.

D1, D2 and D3 block positive feeds via the lamp, etc.

R11 and R12 provide discharge paths for C2 and C3.

The circuit should operate with relay coil resistances of between 200 ohms and 1K.

Substitute transistors could be used. When components other than those specified are used, it may be necessary to alter the values of the following resistors, bearing in mind that the lower the value of resistance, the shorter the delay time. and vice versa.

R5, to set excite time (about 10 seconds).

R1, to set horn operating time (45 to 60 seconds).

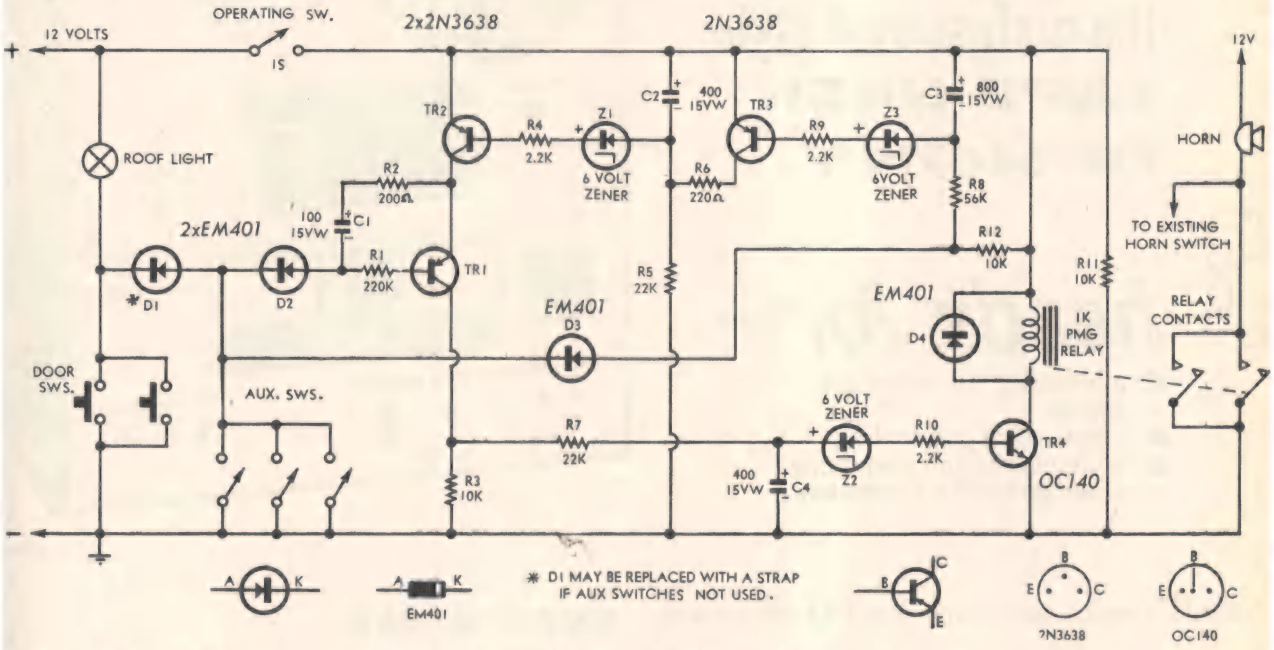
R7, to set enter time (about 10 seconds).

R8, to set horn time for open door. (45 to 60 seconds).

The circuit is designed for negative earth systems. For positive earth, reverse all diodes. zeners, and capacitors, use NPN instead of PNP transistors, and vice versa.

(Submitted by: Mr I. Robertson Originally published: August, 1969, p. 107.)

Reference: "Car Burglar Alarm" May, 1970, p. 107.



Main feature of the alarm system is a set of delay circuits to allow legitimate entry and exit without triggering the alarm.

Light warning

(Continued)

that the buzzer was too noisy in the confined space of the car.

To inhibit the buzzer action when the ignition is switched on. current is fed from the ignition circuit directly to the buzzer coil, i.e., not via the buzzer contacts. Thus the armature is permanently attracted to the electromagnet, the contacts held open, and the buzzer cannot function. Resistor R2 is used to limit the current through the buzzer to no more than is necessary to provide a positive inhibiting function. In addition, R1 and R2 collectively prevent any interaction between ignition and light switches.

The two leads from the buzzer were connected directly to the light switch and the ignition switch. In the latter case. the "accessory" ignition contact was used, rather than the normal ignition contact. This allows the buzzer action to be inhibited — by turning the ignition switch to the "accessory" position — while the lights remain on, should this be desirable during any condition of night time operation.

(Submitted by: Mr W. S. Herlihy. Originally published: November, 1968, p. 97.)

Reference: "A Light Minder for Your Car." April, 1966, p. 67.

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A READER BUILT IT . . . continued

Solid state voltage regulator

The electrical system of the modern motor car uses mechanical switches for the vital functions of cut-out, voltage regulating, and current limiting. While these are capable of doing a good job when correctly adjusted, they are likely to wear, stick, pit, and otherwise deteriorate. The all solid state system described below is claimed to be free of all these problems, as well as offering other worthwhile advantages.

At the time of writing (1967) this regulator has been operating for nine months without fault in an FC Holden.

The total cost is about $7 in parts and it fits into the same space as the original electro-mechanical regulator.

In place of the conventional mechanical 'cut-out.' the system uses a diode; a 1N3491-R by Delco. This is a push fit diode which is fitted into a ½-inch hole drilled into the generator assembly. This diode could be fitted in the positive lead, but thermal considerations dictate that it must be mounted on a reasonably large heat sink (100 sq. in.) which — in the positive lead arrangement — would have to be isolated from chassis. In addition this heat sink must not have any thermal contact with the regulating power transistor (2N441) heat sink because of leakage problems associated with high temperature on germanium transistors.

Other modifications which need to be made are:

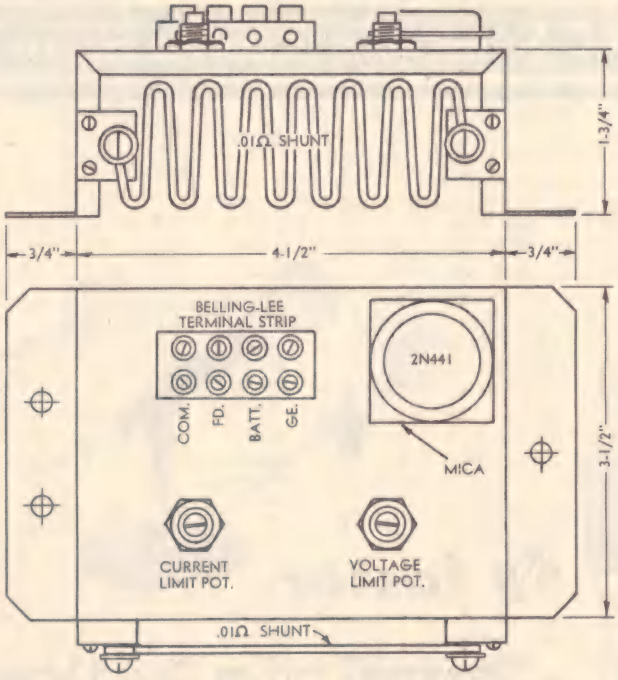
The generator negative brush must be insulated from chassis.

The field winding connections need to be modified so that both are insulated from chassis.

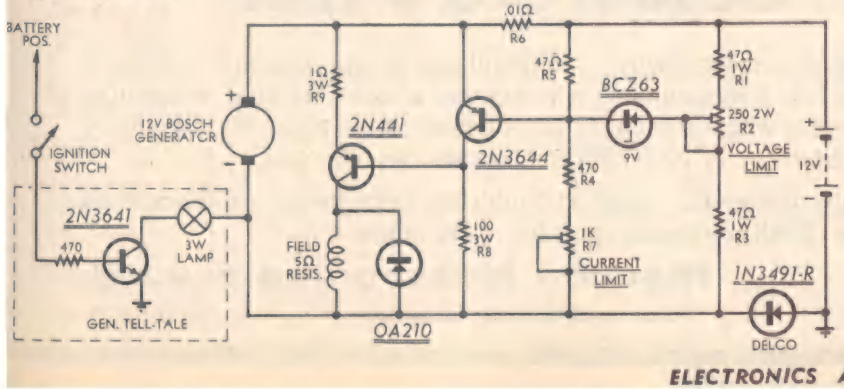
The maximim dissipation of the 2N441 is 6W and hence it can be mounted on a heat sink with a total area of 18 sq. in., assuming a worst case ambient temperature inside the engine compartment of 50 degrees C (122 degrees F). In my case, I mounted it on a chassis in which all the associated wiring was housed. A mica washer was used to electrically insulate the transistor case from the heat sink.

(Continued on page 103)

Plan and side elevation of the finished regulator, designed to fit in the same space as the conventional unit. Note the location of the heavy duty .01 ohm resistor.



Below: The complete circuit of the regulator. Note that both generator brushes and field connections need to be isolated from chassis. R6 is the heavy duty resistor illustrated in the layout diagram above.



A READER BUILT IT . . . continued

Turn indicator warning

For those who forget to cancel their turning indicators here is a simple audio oscillator which will remind you.

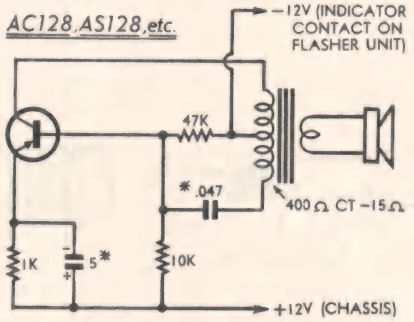
When the trafficator switch on my van failed, the replacement had no provision for mounting a warning light. I therefore produced the following device which has worked perfectly ever since.

It is a Hartley oscillator with a fundamental frequency somewhere about 1KHz. Though designed for 12 volts I have tested it on 6 volts and can guarrantee that it will work, though output is slightly lower. For 24 volt systems a transistor with higher ratings would be needed.

There is no need to use a new speaker — the one I am using had been discarded because of a slight voice coil scrape.

Fit one of these to your car and you'll never forget your blinkers are on and mislead other motorists. It's also a great conversation piece and passenger puzzler.

The author suggests a number of transistors which can be used but, of these, we feel that only those shown on the circuit, or ones with similar ratings, are suitable. The others have a maximum collector voltage of 20, whereas the peak voltage swing from a 12 volt supply would be 24 volts, and possibly higher when the battery was charging.



(Submitted by: Mr H. Swan. Originally published February, 1967.)

Voltage regulator . . . continued

Because the cut-out diode is in the negative lead, and the present system employs a cut-out in the positive lead a phase inverter is required for the generator tell-tale light. The phase inverter circuit is shown in the dotted block of the circuit diagram.

The operation of the voltage regulator is best explained by first considering the resistors R_1 R_3 and R_4. These form an adjustable voltage divider across the battery. When battery voltage is low the divider voltage is low and the BCZ63 (zener diode) does not conduct. Therefore the 2N3644 transistor does not conduct and all current through resistor R_5, is directed into the regulating power transistor (2N441). hence full output is obtained from the generator.

As the battery voltage rises, the zener diode begins to conduct, supplying base current to the 2N3644 which in turn diverts current through R_5 away from the 2N441 base. Hence field current drops and lower generator current results. Adjustment of voltage limit is obtained by varying potentiometer R_4.

Current limitation, to protect the generator under extreme conditions such as a flat battery and/or very high engine speeds for long periods is provided by means of the .01 ohm resistor (R_6). When current flows through the battery a voltage is developed across R_6. This voltage is applied across the base emitter junction of the 2N3644. constituting a forward bias on the transistor. As before, this reduces field current and generator current to an acceptable limit. Adjustment of this limit is obtained by varying potentiometer R_7, which varies the initial bias on the 2N3644. The .01 ohm resistor consists of 20in of 1/8in diameter steel fencing wire.

To adjust the system first connect an ammeter into the battery lead and turn down the voltage limit potentiometer R_4 to zero (to prevent the voltage limit from working). Start engine and rev to 2000rpm. Adjust R_7 until the desired current is obtained (20 to 30 amps).

Adjustment of voltage limit can be achieved by two methods.

(1) If the battery is fully charged it will have a voltage of 13.5 to 14.1 volts and hence the voltage limit may be adjusted to give a fully charged current of 3-5 amps.

(2) If the battery is in a partially discharged condition, connect a 0.5 ohm resistance in series with the battery lead and connect a voltmeter between the "hot" side and chassis. Adjust the voltage limit until the voltmeter reads 14.0 volts.

This method of setting up should be accurate enough, but a final touch up of R_2 and R_7 may be needed. Once set up the potentiometers should never need to be adjusted again, even when a new battery is installed.

(Submitted by: Mr P. D. Kay. Originally published May. 1967.) Reference: "Popular Electronics," June, 1967.

(Editor's Footnote: "Reader Built It" projects are published for the general interest of experimenters and as a source of ideas. Based on readers' contributions, they have not been tested in our laboratory and we cannot accept responsibility for them.)

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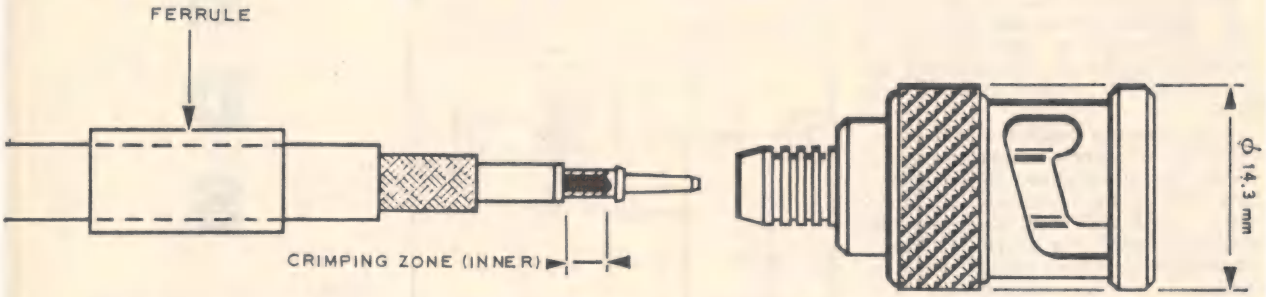

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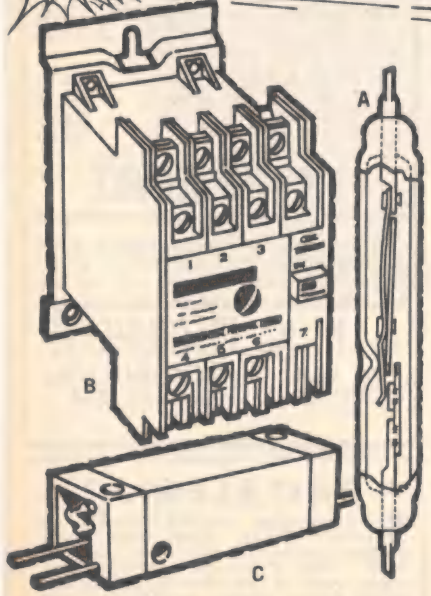

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A READER BUILT IT . . . continued

Windscreen wiper control

One of the devices which has come in for a lot of attention in previous "Reader Built It" contributions is the windscreen wiper. Here are two descriptions of how to achieve pulsed operation, suitable for very light rain conditions.

The following describes a modification I made to the windscreen wiper circuit of my car to eliminate the annoyance of running the wipers continually in light showery weather. It has the effect of causing the wipers to give one sweep, park, and pause 5 seconds before another single sweep. It could be fitted to any car having self-parking electric wipers.

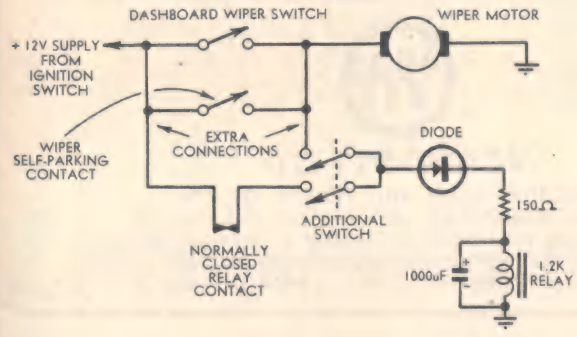
I found that the values given on the circuit gave satisfactory results for most light showery conditions.

On closing the additional switch, the wiper operates immediately and the relay picks up after a delay of about half a second, determined by the 150 ohm resistor and the capacitor, and opens its contact. After one complete sweep, the self-parking contact opens, the motor stops, and the capacitor begins to discharge through the relay, which eventually de-energises, closing its contact. This sets the wiper motor going again, and re-energises the relay coil.

The diode (any low power type) is necessary to prevent the capacitor from discharging through the motor instead of the relay. Polarities are shown for a negative frame car.

If variable timing is desired, a rotary switch could be used to switch in more or less capacitance. (1000uF gave 5 seconds. 1500uF gave 7½ seconds with the 3000 telephone relay used.) Or possibly a switch pot, with the rheostat in series with the relay coil, could be used.

(Submitted by: Mr D. Orames. Originally published February, 1967.)



At left: A simple modification to the windscreen wiper circuit provides pulsed operation at a selected rate.

Solid state version

Inspired by the circuit above, it wasn't long before another contributor came up with a solid state version. While not as simple as the previous one, it is rather more versatile.

I adapted the accompanying circuit from a note in the Motorola Semi-conductor Circuits Manual (available locally) and it has worked very satisfactorily in my vehicle for some months.

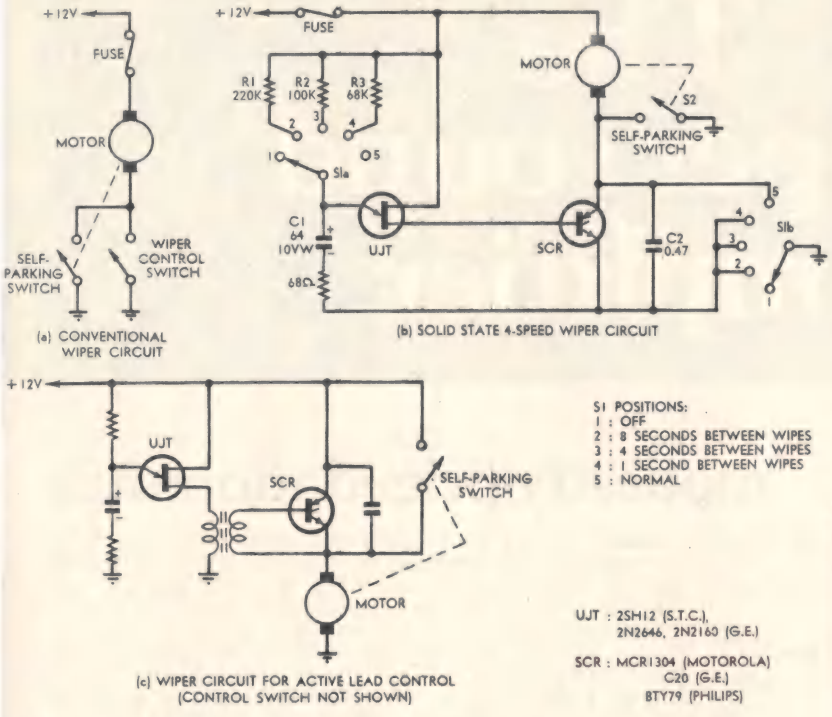
A simple unijunction transistor trigger circuit provides a range of repetition rates dependent on R1, R2 or R3 (selected by S1) C1, and the standoff ratio of the UJT. When SCR is triggered by UJT, the wiper motor begins to operate and closes the self-parking switch S2. S2 short-circuits the SCR, turning it off, and carries the motor current for the remainder of the wiping cycle at which time the motor stops (S2 opens). The wipers remain in the rest position until the next UJT trigger pulse initiates another wiping cycle. C2 protects the SCR and the contacts of S2 from voltage transients caused by opening of the motor circuit.

In my circuit the control switch S1 selects: off; 8, 4, and 1 second between wipes (approximately), and full speed. Some experimentation with resistor values is necessary, depending on the range of speeds required, the value of the timing capacitor C1 (50 to 100uF) and the UJT characteristics. The SCR can be any type rated at 4 or 5A RMS or more, at a PIV of 25V or more.

The low duty cycle makes a heat sink unnecessary. All components are wired between the control switch S1 (a two-pole, five-position wafer switch) and a lug strip mounted on the rear of S1. The control switch is mounted on the dashboard of the original control switch.

The circuit shown is applicable to vehicles having motor control in the

A READER BUILT IT . . . continued

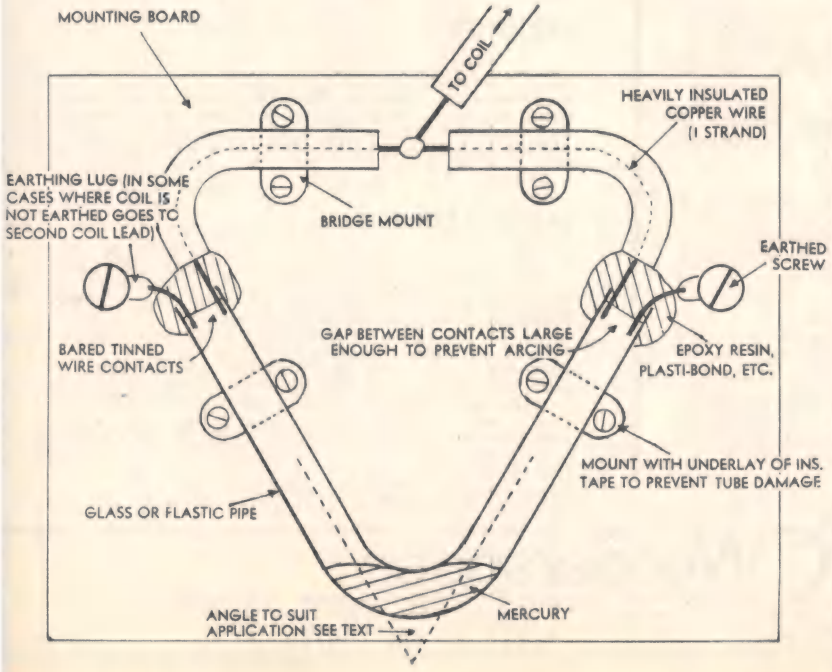


chassis side (e.g. Holden). For vehicles with control on the active side, a simple pulse transformer is required, as indicated.

(Submitted by: Mr C. S. Fisher. Originally published June, 1967). Reference: "Pulse Control of Two Speed Windscreen Wipers." December, 1967.

Motor cycle safety cut-out

If a motor-bike turns over (in an accident or a sharp turn), the rider is exposed to a great deal of danger from the cylinder, or cylinders on the engine bursting or having their heads blown off. Added to this is the danger of spilt petrol igniting off sparks from torn exhaust pipes or burst cylinders, not to mention the hazard of fast moving chains and cogs. Most of this danger can be eliminated by turning the engine off in a crash, but this is hard to do in the split second between impact and separation of rider and machine.



This device is useful in these circumstances, is cheap and easy to make and needs little maintenance. It consists of a piece of bent plastic or glass tubing in which a globule of mercury is free to move. Should the bike tilt too far, the mercury shorts the ignition coil to earth, stopping the engine almost instantly.

The unit is mounted on a suitable board (¼in masonite etc), wrapped in foam rubber and placed in a wooden or metal box mounted vertically across the frame parallel to the handlebars and away from the engine.

The angle at the bend is chosen to suit the application. If too large, the bike will stop when rounding a corner: if too small, the engine may not cut out. The correct angle will lie between about 20 and 110 degrees.

(Submitted by: Mr Lindsay Ford. Originally published October, 1967.)

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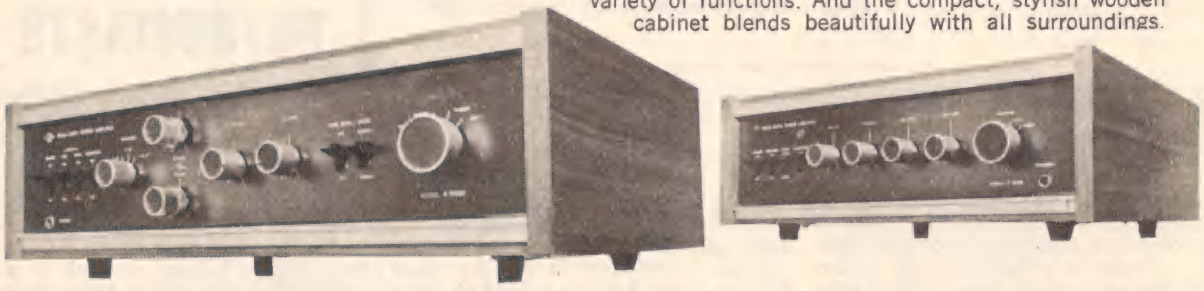
The Monarch A-5000 is a truly solid state stereo amplifier offering finest laboratory precision performance for your home entertainment. It has 80 watts of Total Music Power (IHF at 8 ohms); Dual-channel IC Equalizer for perfect balance; Special Protection Circuit against overload; Latest all-silicon transistor circuitry. Complete array of front panel controls and switches, too. And the distinguished oiled walnut cabinet adds a touch of real status to your decor.
The Monarch A-3000 offers all the desirable features of a quality solid state stereo amplifier of latest design. It has 50 watts of Total Music Power; Direct-coupled transistor output for clean, distortion-free audio response; Built-in automatic overload protection; Complete array of controls and switches for full variety of functions. And the compact, stylish wooden cabinet blends beautifully with all surroundings.



—MONARCH A-5000 R.R.P. $189

FACILITIES

Front Panel: Selector—TAPE HD; PHONO; TUNER; AUX • Mode — STEREO/MONO • Tape Monitor • Volume • Balance • Treble • Bass • Speaker Switch — A, B, A+B • Loudness • Hi Filter • Low Filter • Power • Phones Jack.
Rear Panel: Input—TAPE HD; PHONO; TUNER; AUX; TAPE IN • TAPE OUT DIN jack for tape recorder • MAG-CER switch • AC OUTLET (unswitched) • Speaker Terminals.

SPECIFICATIONS

Output Power: 80 watts (total IHF music power into 8 ohms); 30 watts RMS each channel into 8 ohms
Harmonic Distortion: 0.2% (at 25 watts output level)
Power Bandwidth: 20—30,000 Hz (–3dB; 0.5% distortion)
Frequency Response: 15—40,000 Hz (–2dB)
Channel Separation: Over 50 dB
Output Impedance: 4—16 ohms
Damping Factor: 32 (8 ohms); 64 (16 ohms)
Hum and Noise: Over 60 dB (Phono). Over 76 dB (AUX).
Input Sensitivity: 3mV (Phono); 2mV (Tape HD); 260mV (Tape In); 260mV (AUX; TUNER)
Tape Out: 100mV
DIN Jack Sensitivity: 260mV for Tape In; 30mV Tape Out
Tone Controls and Switches: Bass 50 Hz ± 12 dB; Treble 10,000 Hz ± 10 dB; Loudness 50 Hz + 12dB; 10,000 Hz + 4 dB; Hi Filter 10,000 Hz – 12 dB; Low Filter 50 Hz – 10 dB
Power Consumption: 100 VA
Power Source: 117V, 220V, 240V

—MONARCH A-3000 R.R.P. $144

FACILITIES

Front Panel: Selector—Aux; Tuner; X'tal; Phono • Volume • Balance • Treble • Bass • Loudness • Mode — Stereo/Mono • Tape Monitor • Power • Phones Jack
Rear Panel: Input — Mag; X'tal; Tuner; Aux; Tape Input • Tape Output • Speaker Terminal • AC Outlet • Line Fuse

SPECIFICATIONS

Output Power: 50 watts total music power (IHF) into 8 ohms; 18 watts RMS each channel into 8 ohms
Harmonic Distortion: 0.5% (at 15 watts output level)
Frequency Response: 20 to 35,000 Hz
Power Bandwidth: 20 to 30,000 Hz (–3 dB; 0.5% distortion)
Channel Separation: Over 50 dB
Hum and Noise: Over 60 dB (MAG); 65 dB (AUX)
Loudness: 50 Hz + 12 dB; 10 KHx + 3 dB
Tone Control: BASS 50 Hz + 14 dB — 12 dB. TREBLE 10 KHz + 12dB — 14dB
Input Sensitivity: MAG 2.5 mV; X'TAL 250 mV; AUX 180 mV; TUNER 180 mV
Tape Output: 180 mV
Power Supply: 117V, 220V, 240V A.C.
Size: 345 W x 300 D x 130 H (m/m) • (13½" x 10" x 5")

Australian Distributors: **W.C. Wedderspoon**

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AVAILABLE FROM ALL HI-FI SPECIALISTS IN ALL STATES

AUDIO TOPICS

New pickups promise high quality at low cost

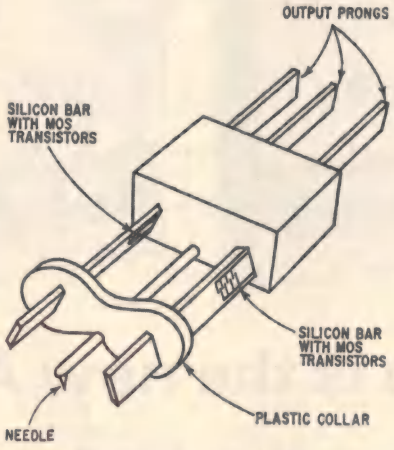
Interesting new developments in the design of stereo pick-up cartridges were announced recently in France and Japan. Both are based on the strain gauge principle.

The French cartridge was unveiled at this year's audio show "Festival International du Son" in Paris, by the Sescosem company. While it is basically of very simple construction, suitable for mass production at low cost, the Sescosem engineers are very optimistic about its ultimate performance — an impressive frequency response of DC to 30,000Hz, tracking at three-quarters of a gram, dynamic mass of only 0.7 milligrams. Compliance of prototype models was 10 microcentimetres/dyne, but it is expected that this can be improved; similarly the 40dB signal to noise radio. On this evidence, the manufacturer expects the cartridge will be a competitor for all but the best magnetic cartridges, and at lower cost.

Strain gauge type cartridges are not new. However, there is an important difference in principle between the earlier types and the new French design. All the earlier types have used semiconductor resistors to translate the movements at the stylus tip into the electric signals required to operate an amplifier. The resistors are powered from a low voltage source, and as their resistance varies according to the amount of stress applied to them by the stylus shank, a modulated current results. Unlike the magnetic cartridge, this type of cartridge does not have to have equalisation circuits built into the input stage of the associated pre-amplifier. Like ceramic cartridges they give an output voltage from standard pressings which is sufficiently "flat" for non-critical situations.

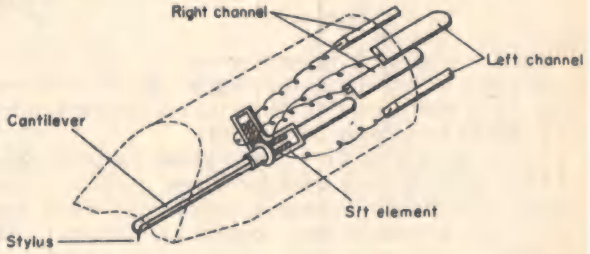
In the Sescosem design, two tiny silicon bars are coupled to the stylus shank to pick up the stylus movements. Each silicon bar has two tiny field effect transistors deposited onto it. These transistors are connected to a power source, and their parameters vary when they are flexed as the silicon bars move in sympathy with the stylus movements. The important difference between the two principles is that the FETs have an amplifying action, so that the cartridge has what is virtually a built-in preamplifier. It can thus be fed directly into a basic amplifier, as in the case of the cheap crystal or ceramic cartridges. The saving in cost which results from this is expected to make the cartridge an attractive proposition for commercial radiograms.

In contrast to the output of magnetic cartridges, typically around 5-6mV, the Sescosem cartridge delivers around 200mV of output from the FET, which is raised still further by the second transistor built onto the silicon bars to around 500mV. The output is therefore comparable with that of the crystal cartridge, but without the attendant disadvantages of poor frequency response, high tip mass, comparatively high tracking weight, and low compliance. Since the Sescosem cartridge does not need equalisation circuits or preamplifier stages, it may be regarded as suitable for use with amplifiers designed for crystal cartridges.



ABOVE: General arrangement of the Sescosem strain gauge cartridge.

RIGHT: Matsushita's cartridge uses a semiconductor film as transducer.



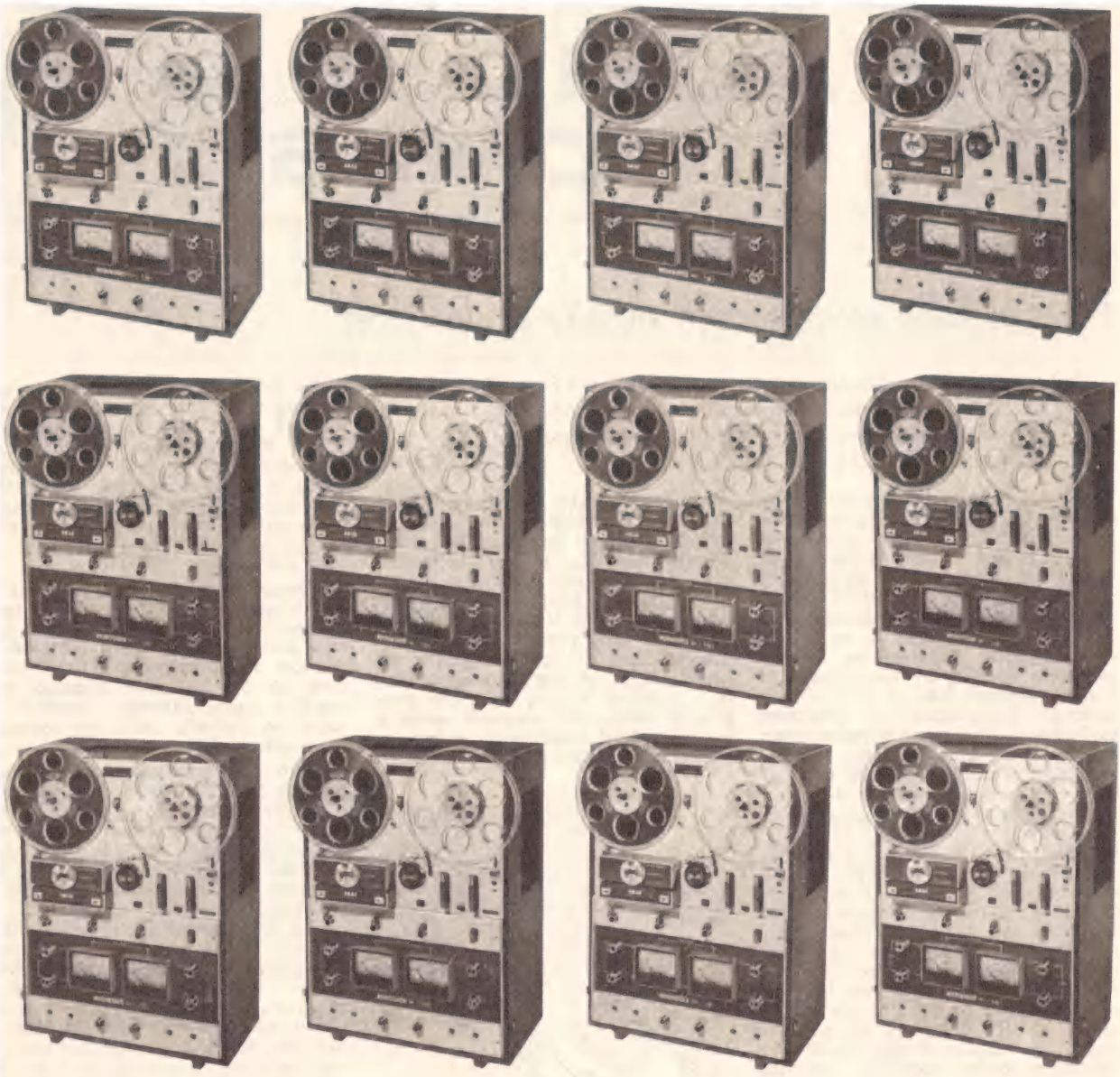
A report on the Sescosem cartridge in the March 16, 1970 issue of "Electronics" indicates that the cartridge was designed almost by accident:

"When Sescosem launched its strain-gauge cartridge project six months ago, its engineers were not dreaming of elbowing out magnetic cartridges, but of finding a cheap, medium quality cartridge for the $400 hi-fi sets that are winning a growing share of European markets. Since 1962 the company has been studying the influence of mechanical strains that limit carrier speed in semi-conductors. Tying the amplifying abilities of MOS transistors to the current varying prowess of a silicon strain gauge turned out to be an ideal marriage.

"Design of the Sescosem cartridge is surprisingly simple. Two silicon bars measuring 12 x 1 x 0.2mm — one for each stereo channel — are anchored at the rear of the cartridge. At the front, they are free to move whenever the tracking needle transmits vibrations by means of a plastic collar that connects the needle to the silicon bars.

"Two MOS transistors are deposited on each bar. One transistor serves as a transducer to produce an electrical signal, while the other acts as a load resistor controlling the first. Sescosem has patented this arrangement and says its cartridge is the only one to combine transistors with a strain gauge effect."

This last statement would seemingly indicate that Sescosem engineers were not aware of the Japanese development, reported recently in "Design Electronics" Designed in the research laboratories of the Matsushita company, the pickup uses a germanium semiconductor deposited on an extremely thin film base as a transducer. Like the French design, it is the strain induced into the semiconductor which varies current flow through the pickup. According to the "Design Electronics" report: "The film element has a mass of 0.0001 gram, about one-tenth that of conventional electro-magnetic pick-up elements. No coil or magnet is needed, so the cartridge is exceptionally small (6mm diameter by 16mm long), and exhibits frequency response to 30KHz. Although development of the pickup has been announced, commercial availability is projected for later this year."



Which one is the new Akai M-10?

They all are!

We get carried away every time we turn one on. Ten years ago we introduced the "Big M" series. Since then, thanks to you, these fine stereo tape recorders have sold as fast as they could be produced.
The new M-10 is the finest of the series. Features include AKAI's world famous cross-field head system, 3-speed direct drive capstan hysteresis synchronous motor, separate torque motors and continuous automatic tape reverse.

These coupled with a 40 watt all solid state amplifier, give exceptionally wide frequency response with negligible distortion and extremely low wow and flutter.

The M-10 can be used with its own inbuilt loudspeakers or with your choice of external speakers. Ask to see the AKAI range.

The M-10 is available in either oiled wood or vinyl cabinets.

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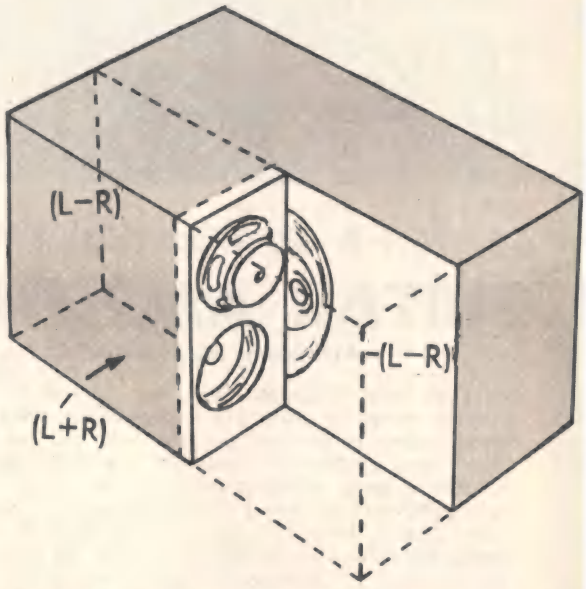
STEREO FROM A SINGLE ENCLOSURE

From the U.S.A. comes news of a single unit stereo loudspeaker system which is said to provide an impressive stereo effect from a single cabinet, using the mid/side principle and "acoustic matrixing." It is intended for use in situations where it is clearly impractical to use conventional stereo installation.

The system is being marketed by the well-known Jensen company under the name "Stereo 1 (S-100) Speaker System." It represents an entirely new approach to the provision of stereo sound, based on what is known as the mid/side principle, and uses no left and right loudspeakers in the conventional sense. Instead there are sum and difference loudspeakers, which provide the "mid" and "side" elements of mid/side stereo by interaction. The physical arrangement is shown in the illustration. There is a large centre unit facing outwards, and two smaller units facing in opposite directions on a mounting board.



This diagram shows how the three loudspeakers are arranged in the Jensen Stereo 1 system.

Information available so far on the elements used in the construction is sketchy, but seems to indicate that no frequency crossover networks are used, so that each of the three loudspeakers is supplied with the full frequency range. The side-facing units, being essentially unbaffled, do not reproduce the low frequencies, but since their output is derived from the difference signal (L — R) presumably they are not required to do so.

The outputs from the two stereo channels are fed to a "matrixing transformer" mounted inside the cabinet. Here, left (L) information is added to right (R) information and applied as a summed signal (L + R) to the centre, outward-facing unit. At the same time, the difference signal (L — R) is applied to the two sideways-facing units, but these are connected out of phase. Since they face in opposite directions, the result is effectively two in-phase units.

When the system is handling a mono signal, there is no difference component (L — R), so that the only signal radiated is from the centre unit. However, when a stereo signal is applied, the L—R component interacts acoustically with the L + R component to produce different effects on the respective sides of the system, as follows:

$$(L+R) + (L-R)=2L$$

to give the left channel output; and

$$(L+R) - (L-R)=2R$$

to give the right channel output.

So much for the theory, but does it work in practice? To judge from the subjective reaction of American writers, it does, and to the extent that it has evoked comments such as "nothing short of amazing" and "a good stereo image." On a more practical plane, Jensen engineers have conducted measurements with directional microphones to prove that the stereo spread is actual and not based on an illusory effect.

The makers are careful to point out, however, that the system cannot reproduce the exaggerated "ping-pong" effects used to demonstrate stereo systems in the early days. However, a spokesman for the company commented, without noticeable modesty: "Mid/side stereo is subtler than the extreme effects we used to play around with in the days when stereo was new, but the technique is responsible for some of the finest stereo sound you can get these days."

While American observers were impressed by the ability of the system to provide an effective stereo spread they were not so enthusiastic about the overall performance, and classified the system as "medium-fi rather than hi-fi." Performance is satisfactory in the mid-range, they say, but falls off at the high and low ends. Because of the physical arrangement of the drivers, sound is constricted on mono program material, as only the forward facing speaker is operating, and this is partially blocked by the two sideways-facing units and their mounting panel.

However, the manufacturers have emphasised the ability of the system to provide a realistic stereo sound from a single unit, rather than to replace conventional loudspeaker set-ups. It therefore appears that the main use for the new system would be to provide a stereo effect in situations where, for various reasons, a conventional stereo pair could not be used. ■

Australian Stereo Broadcasts in 1927

Browsing through an old copy of "Wireless Weekly," one of our staff members came across this reference to stereo broadcasts conducted as long ago as 1927 by Station 6WF in Perth.

With the usual broadcast transmission using one wavelength and one microphone, the listener although he may be using two ear pieces is really only hearing the music as if he were listening with one ear. One may look upon the microphone as the actual ear of the listener. Using one ear the sense of direction of sound is not possible, the same applies with using one microphone. It is only by the use of both our ears that we are able to judge in what direction sound is coming from so that is is necessary to use two microphones and two separate wavelengths to give the listener that natural soundness and sense of direction that one is so accustomed to when listening to sound.

Recently 6WF carried out a unique experiment. During an orchestral program from the studio two microphones were arranged at a distance 6 to 8 inches apart, to represent the ears of the listeners. The microphones were then connected to the 100 metre and 1250 metre transmitter, respectively.

Those listeners in possession of a short wave receiver in addition to the usual broadcast receiver were previously instructed by a brief talk broadcast from 6WF to proceed as follows:

Adjust each receiver so that the volume on 100 metres was equal to that received on 1250 metres, take one of the earpieces off the headphones connected to the short wave receiver and interchange it with an earpiece of the headphones connected to the 1250 metres receiver. Listening-in in this manner i.e., with an earpiece connected to the 100 metres on one ear and the earpiece connected to the 1250 metres receiver on the other ear, the effect is most natural. In addition to a certain roundness that is lacking in the usual broadcast reception, one can distinguish quite easily which instruments are to the right or left of the microphone, and one has a feeling that the music is actually being played in the room.

Judging from the numerous letters of appreciation, there must be quite a number of listeners in the West who possess a short wave and long wave receiver. ■

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40 Watt & 60 Watt Instrol-Playmaster

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Like all Instrol-Playmaster kits, the 116 and 117 Guitar Amplifier Kits are complete in every detail, down to the last nut and bolt, and precisely to "Electronics Australia" specifications. Chassis is ready drilled, cadmium plated and finally passivated to avoid fingermarking. The front label is beautifully finished with black lettering on silver-white background. Kits for both the 116 and 117 include extras such as 3 inputs (circuit included), vibrato and extra treble pull switches, and foot switch complete with chrome housing.

	PRICE
40 Watt complete kit of parts	**$84.36**
40 Watt built and tested	**$91.49**
60 Watt complete kit of parts	**$92.31**
60 Watt built and tested	**$98.83**

(Freight extra)

All parts available separately if required.
Chassis only . . . . . **$4.70** (plus 85c postage)
Front Label . . . . . **$2.80** (plus 20c postage)
Fuzz Box Kit . . . . $12.95 (plus 75c postage).

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NEW E.A. SOLID STATE COMMUNICATIONS RECEIVER

Its features include high stability with tunable IF, excellent IF skirt selectivity and provision for AM, CW and SSB reception.

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These robust and attractive meters are available in the following sizes:
VP4A 1½" x 1½"
VP3A 2½" x 2"
VP2A 3" x 2½"
VP45 2" x 2"

Also Available, meters with scales to suit the following projects.

EW2 ¾" x ¾"
EW5 1¾" x ¾"

Transistor Tester, Aug., 1968.
Audio Generator, Sept., 1968.
Power Supply, Sept., 1968.
F.E.T. Voltmeter, Dec., 1968.

METERS

VP4A	0-500 microamps . . .	**$4.81**
VP4A	0-1 milliamp	**$4.81**
VP3A	0-500 microamp	**$5.27**
VP3A	0-1 milliamp	**$5.16**
VP2A	0-50 microamp	**$7.11**
VP2A	0-500 microamp	**$5.96**
VP2A	0-1 milliamp	**$5.86**
VP45	0-500uA V.U. scale . . .	**$4.81**
EW5	0-200 microamp V.U. . .	**$3.43**
EW5	0-200 microamp	**$3.43**
EW2	0-150 microamp	**$2.51**

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PLAYMASTER 127 CONTROL UNIT

A fully solid-state control unit incorporating a dual linear integrated circuit and providing equalisation to CCIR and RIAA specifications for tape replay and magnetic disc pickups. (Refer November, 1969).
Kit of Parts $47.65
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(Aluminium knobs are $2.20 extra).

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A high-powered transistorised stereo amplifier for use with the No. 127 Control unit, providing a performance equal to most imported amplifiers at half the price. (Refer January, 1970.)
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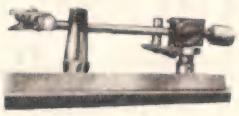
The only record playback system engineered for stereo cartridges that can track as low as 0.1 gram.

THE NEW TROUBADOR 598

A turntable system designed exclusively for the new low-tracking-force cartridges that don't wear out your records, this unbelievable record playback device exceeds every National Association of Broadcasters (U.S.A.) specification for professional playback equipment.

1. This extraordinary Troubador system features the Empire 990 — world's most perfect playback arm. Built to last with rugged precision foolproof adjustments. Arm friction measures a minute 1 milligram. A tone arm that applies no more drag than a feather held lightly against a record groove.



2. Arm fully stereo balanced — front as well as rear of pivots.
3. Sealed instrument ball-bearing races for horizontal as well as vertical motion.
4. Stylus force dialled with calibrated clock main-springs — more accurate than any commercially available pressure gauge.
5. Lowest fundamental resonance of any arm, an inaudible 6Hz, makes it impossible to induce acoustic feedback in the system even when you turn up the gain base.

6. Empire's exclusive Dyna Lift automatically lifts the arm off the record at the end of the music.
7. Micrometer calibrated anti-skating adjustment can be set exactly to match any operating force for conical or elliptical styli. Eliminates uneven record or stylus wear.
8. Instant cartridge demount and interchange.
9. In-line-stylus-to-pivot axis. No warp, wow or cosine-error distortion.
10. 5-wire circuit eliminates ground loops.
11. World's finest turntable motor. hysteresis synchronous type, self-cooling, high torque with inside-out rotor; reaches full speed in less than 1/3 of a revolution and locks in on AC line frequency; maintains speed accuracy with zero error. Built-in strobe disc and pitch control.

12. Flexible belt drive precision ground to plus—minus .0001 in. tolerance.
13. 12-inch turntable platter and 4-inch balanced drive fly-wheel—most massive ever used in a home system.
14. Microphoned oilite bearing and lapped chrome steel shafts machined as individually matched pairs—no production-line tolerances.
15. Lowest rumble of any turntable tested minus 90 DB (RRL). Wow and flutter an almost numerous .01%.
16. Customised record mat holds records by outer rim. The playing grooves never touch the mat on any size record.
17. Empire's exclusive pneumatic suspension combines pistons and stretched springs. You can dance, jump or rock without bouncing the stylus off the record. Tracks the world's finest cartridge as low as .1 gram.

TECHNICAL SPECIFICATIONS

Empire 598 Turntable
3 speeds — 33 1/3, 45, 78 r.p.m. Push-button power control built-in 45 r.p.m. spindle.
Overall dimensions (with base and dust cover): 17½in W x 15¼in D x 8in H.
Dimensions (without base and dust cover): Width 16in, Depth 13½in. Height above mounting surface 3¼in. Depth required below base plate 3½in. **Swiss ground gold finish.**

TROUBADOR 598 PLAYBACK SYSTEM, made in U.S.A., for free colour brochure write to RECORDED MUSIC SALON, Sole Agents for Australia.

THE EMPIRE 1000 ZE IS UNDISPUTEDLY THE WORLD'S BEST.

Each 1000 ZE cartridge is individually calibrated to have a flat frequency response within plus or minus DB from 20-200,000 Hz. There are no electrical or mechanical resonant peaks and total IM distortion at the standard 3.54 cm/sec groove velocity does not exceed .05 p.c. at any frequency within the full spectrum. Stereo separation is better than 45 dB at 1 KC and remains at least 25 dB or better all the way out to 20,000 Hz. Overall frequency response 4-40,000 Hz. Output voltage 5 mv per channel.

The 1000 ZE tracks effectively at stylus forces as low as 0.1 gram and never subjects the disc, whether it is vinyl pressing or master lacquer, to any visible wear or groove deformation.

The Empire 1000 ZE Stereo Calibration Standard, price in U.S.A. $99.95. Price in Australia: $100.

The full range of Empire cartridges and styli is always in stock. They are as follows: Model 808, 808E, 888, 888E, 888TE, 888VE, 999VE, and 1000ZE.

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Unit 1: Akai tape deck, Model 4000D . . . . . Retail Price: $330.00
Rogers Ravensbrook amplifier, power output 15 plus 15 watts RMS into 8 ohms. 1 kHz, frequency response 0 dB 10 watts into 15 ohms. " " $215.00
2 Wharfedale Super 8 RSDD loudspeakers . . . . . " " $ 71.00
$616.00
YOUR SPECIAL PRICE: $394.00.

Unit 2: Ampex tape recorder, Model 2100, automatic threading and reverse, bi-directional recording. Plus 2 Jordan Watts loudspeakers, frequency range, 30-17,000 Hz plus or minus 3 dB.
Retail Price: $765.00
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Unit 3: Beware of cheap, low quality tapes. They cut the heads on your tape recorder, and rapidly destroy its reproduction. Buy **AMPEX**, the world's best tapes. They cost you 20% less than the average tape on the market. For instance:

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1800ft x 7in	"	$8.50	"	$6.80
2400ft x 7in	"	$11.30	"	$9.00

Unit 4: Armstrong Model 521 stereo amplifier, power output, continuous sine wave, 25 watts per channel 8 ohms. Power bandwidth 20-25,000 Hz. Retail Price: $240.00
Dual 1209 turntable . . . . . " " $130.00
Empire Model 888 cartridge, frequency range: 12-25,000 Hz . . . . . " " $ 30.00
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Four-channel recording of Verdi's "Requiem"

For those who want it, four-channel sound reproduction looks like becoming a reality in the not-so-distant future. What may be the first commercial release of a four channel recording was made recently by CBS Records in London's Royal Albert Hall.

by John Borwick

As I sat in the audience in the Albert Hall on Sunday, 22nd February, 1970, I found myself taking more than my usual interest in the internal balance of the orchestra, chorus and soloists and the acoustic contribution of the hall itself. The occasion was the much heralded performance of the Verdi "Requiem Mass" with Leonard Bernstein conducting the London Symphony Orchestra and Chorus and distinguished soloists.

The reason for my heightened interest in the technicalities of the performance (though I was also able to thrill to the successive textural delights of this most dramatic of requiems) was that I had been invited by Miss Quita Chavez of CBS Records to attend the recording sessions during the following week. Ever since the Royal Albert Hall echo was tamed by hanging "flying saucer" absorber/reflectors in the great dome (see "Electronics Australia," January, 1970) I have been expecting the record companies to begin using it for large scale works.

Now CBS were taking up this idea and, something very topical at the moment, they proposed to make the recording in the new quadraphonic four-channel system. Stirrings of this technique in America were mentioned recently. (See "Four Channel Stereo On The Way?" in the February 1970 issue of "Electronics Australia.")

The situation in conventional two-channel stereo recording and reproduction is illustrated in figure 1. Twin microphones are used to record left and right tracks which, when reproduced through twin loudspeakers, give the listener the impression of an orchestra spaced across the angle formed by the speakers and the listener. Notice that, while in ideal conditions the orchestra appears to occupy a space which is a kind of extension of the room, all the reverberant sound or ambience comes from the two speakers and there is no real feeling of being present in the concert hall.

Four-channel recording (see figure 2) adds a pair of microphones aimed at the back of the auditorium and recorded on separate "ambience" tracks. Now, it is claimed, the listener can sit in the middle of his four speakers and re-live the same acoustic experience he would have enjoyed at the live performance. The two rear speakers are radiating mainly ambient sounds and since this mostly comes from behind an audience, the effect is just as if the listener was surrounded by the original auditorium as in my sketch.

I was warmly welcomed by the CBS producer from America, Tom Shephard, the Head of CBS (Classical) London, Paul Myers and one of Britain's well known recording engineers, Bob Auger, who was to manipulate the controls.

To the uninitiated, the recording gear put in for the CBS sessions by Granada Studios looked impossibly complicated.

They led me down to the improvised control room, made out of part of the Bar close to the Conductor's Room under the platform. A 16-channel control console was installed feeding an 8-track tape machine using one-inch wide tape and eight Dolby noise reducing units — one for each track. Basically, three of the tracks were taking the orchestra sound (mixed down from about nine microphones), three more were for voices (four solo plus four chorus microphones) and the remaining two tracks were recording the output of the ambience microphones. Monitoring was on two large loudspeakers at the front end of the room and two much smaller speakers at the back.

I was allowed to listen to many of the "takes" and, comparing these with the sounds I heard on frequent trips into the hall itself, I can confirm that Leonard Bernstein and all the performers have put together a truly exciting performance. As for the overall recorded balance, I shall have to wait until the recording appears before I can comment. It is a feature of multi-track recording that the engineers tend to put as high a signal level as possible on each track. Then at the reduction session, when the eight tracks are mixed down to the final two (or four for quadraphonic recordings), the individual streams of sound are pulled down into balance with each other and this helps to keep background noise to a minimum. Another way in which the sound quality monitored during the recording differs from that of the final product is that a fairly close microphone technique is favoured, giving a dry sound but improved separation between performers. Individual tracks can then have artificial reverberation added at the reduction stage as required.

By the same token, it was not possible for me to reach any final conclusions on the effectiveness of the four-channel technique. There was certainly an impression of added spaciousness, and the entries of the two distant pairs of trumpets in the "Tuba mirum," from somewhere behind my head, were a nice touch. But the recording team were naturally concentrating all their attentions on getting every note of the music safely on to the tape. So they kept the ambience loudspeakers at a fairly low volume and were postponing any decision on their correct balance until the final mixing session.

However, I have been promised a chance to hear the four-channel tapes as soon as they are ready (Messrs Ferrograph have promised to lend me a machine with four-track in-line heads) and I will no doubt be returning to the subject of quadraphonics quite often. The "Requiem" recording will initially be issued on standard stereo discs (towards the end of this year) with the quadraphonic version as a separate exercise, presumably on tape only though a disc method has apparently been worked out. ■

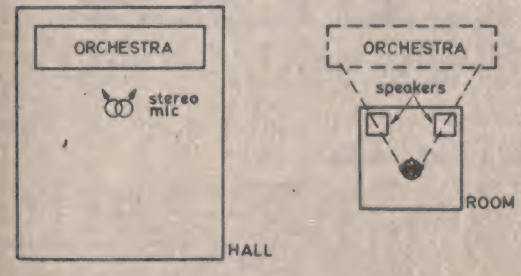


Figure 1. The set-up for two-channel stereo recording and reproduction.

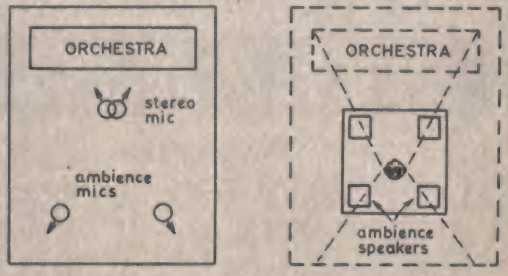
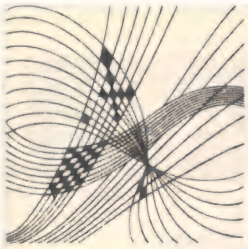


Figure 2. The four-channel system attempts to recreate ambience around the listener.



CLASSICAL RECORDINGS

Reviewed by Julian Russell

VERDI. Otello — complete opera. James McCracken; Gwyneth Jones; Dietrich Fischer-Dieskau and others. Upton House Schoolboys' Chorus; Hammersmith County Schoolgirls' Chorus; Ambrosian Opera House Chorus; New Philharmonia Orchestra conducted by Sir John Barbirolli. H.M.V. Stereo SL940/3.

Having enjoyed Barbirolli's Madame Butterfly so much I looked forward to listening to his new Otello with equal enjoyment. I am afraid that though it has its fine moments there also some disappointing ones. Let us start with its good, sometimes very good, points. In the more lyrical parts of the score — the Act 1 love duet and Desdemona's scene in the last act — Barbirolli dwells on the beauty of the music but at the same time provides you with the opportunity to share his enjoyment without embarrassment. But where, in the spots I have mentioned, he can reduce the tempo with justification, there are other places where such treatment slows up the action and frustrates the drama built so carefully into the music. I would mention in particular the great scene between Otello and Desdemona in Act 3, where Barbirolli seems to deliberately impede the natural progress of the music.

Gwyneth Jones tackles the horrifically difficult role of Desdemona like a veteran and, except for very occasional unsteadiness, gives a performance every bar of which I enjoyed. Moreover she gets right into the skin of the part with its many changes of mood without any sacrifice of tonal purity. I found it a profoundly moving portrayal both vocally and dramatically.

Even in terms of del Monaco's anything but subtle performance of the title role in the old Decca set, James McCracken often sounds a shade too magniloquent in the new H.M.V. True he has his splendid moments, too numerous to record in detail. But he has, too, moments when it becomes a question of "tearing a passion to tatters," to use an overquoted phrase. In the vastness of a great opera house such exaggerations might pass unnoticed but not in the intimacy of your music room.

Another performance that offers difficulties of assessment is Fischer-Dieskau's Iago. There are times when he sounds as melodramatic as a pantomime devil, but there is not a single bar in which exquisite detail of phrasing and purity of production do not persuade one to accept the dramatic limitations.

The orchestra is good, though there are sequences where a stronger drive than that given by Barbirolli would have been appreciated. The ballet music is mercifully omitted. And though the balance between singers and orchestra is generally good, I was disappointed not to hear more of the magnificent backstage fanfares that greet the arrival of the ambassadors at the end of Act 3.

If, however, I have dwelt rather more on the faults than the virtues of this new set there will surely be many who will enjoy being taken through a reading such as Barbirolli's. But they will just as surely be those who have never heard the old Toscanini set, still, despite its age and recording quality in my opinion the best ever made. By the way, I learned from RCA that they have no intention of reissuing the set. The chorus sings well throughout the new H.M.V. though their Italian diction often leaves something to be desired.

★ ★ ★

HINDEMITH. Cardillac — complete opera. Dietrich Fischer-Dieskau; Lenore Kirschstein; Donald Grobe and others with the Cologne Radio Chorus and Symphony Orchestra conducted by Joseph Keilberth. DGG Stereo SLPM139435/6.

This is the original version of the opera composed in 1927. Twenty-five years later, Hindemith produced a revised version in which, because of his change of artistic attitude, he introduced a closer psychological relationship between the music, the characterisations, and the dramatic action. He still retained the outline of the original in its division into separate musical numbers. In the first version, under review here, the music is sometimes curiously detached from what is happening on the stage. Thus a macabre seduction scene is accompanied by a flute duet giving it something of the quality of an 18th century ballet. After some thought this is not quite so anachronistic as it might first seem. The libretto is based on a bizarre story by E. T. A. Hoffmann which tells of a Parisian goldsmith during the reign of Louis XIV who is so enamoured of his own artistic creations that, after having sold them, he later murders the customers in order to get them back.

Now having learned that the opera has a 17th-18th century setting you might get my point about the flute duet not being quite so anachronistic as might have been expected though, admittedly, to ears accustomed to "verismo" in opera, it has a very strange sound. In this 1927 version, Hindemith, having rejected romanticism, adopts a linear polyphonic style throughout much of the writing. However this doesn't prevent it from having many exciting moments. You need only to play the first chorus to hear what I mean. And this is helped by the superb quality of the recording. There are sequences that remind one of German expressionism at its most violent; others, with generous use of melismata, which recall 17th century formalism. Some of the music is brutal, some of the most exquisite fragility. The vocal parts are all vilely difficult.

Keilberth drives it all along with great urgency and vitality, offering a bewildering mixture of passion and the impersonal. Much of the opera sounded to me unnecessarily noisy. Fischer-Dieskau gives, in the title role, just the sort of performance one has come to expect from him — musical in phrasing and tonal quality, unfaltering in attention to detail. His daughter, Leonora Kirschstein, though occasionally a little unsteady in pitch, gets through a taxing part with considerable merit. Her lover, tenor Donald Grobe, hasn't the type of voice that appeals to me, but sings his part conscientiously. The chorus and orchestra are fine. This is most certainly not the type of opera that is likely to appeal to admirers of Verdi, Puccini or Wagner, but it might well provide an interesting new experience for those broadminded enough to give it a chance

★ ★ ★

MAHLER — Symphony No. 6 in A Minor. Bavarian Radio Orchestra conducted by Rafael Kubelik. DGG Stereo 139341/2.

I am afraid I am no slavish admirer of the currently fashionable Mahler. He has great moments, great movements, and he has even composed great symphonies, not necessarily his biggest. I am sorry I haven't the space available to develop this theme more fully. But I must say that, some quite wonderful scoring apart, I find much of the material in the first movement of the Sixth Symphony banal and that, in an effort to disguise this, the composer becomes at times either pretentious or sentimental. This music might well, to some, offer deep Germanic soul-searching but in terms of sound it is often, to my ears, just vulgar. The march-like theme that dominates the movement could well be background music for Red Indians galloping to meet U.S. cavalry. Moreover its development borders on frenzy — though I admit that this is probably what the composer intended.

Kubelik's performance is restrained enough to dampen down some of the most obvious vulgarities but I found that he makes too little distinction between the march-like impetus of the first and second movements. He does, however, find just the right contrast in the landler-like trio and brings out, albeit without exaggeration, the many bizarre bars in the Scherzo. Kubelik takes the Andante Moderato as sweetly as can be imagined. There is no inflation, as in the first movement, or head-banging that might pass for irony, as in the second. His is to my mind the perfect interpretation of the slow movement. He sends its solace awry with a sudden twist of mental and physical

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pain. It reminded me of a man enjoying a lovely walk through pastoral surroundings, the sun high, the air cool, the trees and grass green, everything right until he becomes aware of a blister on his heel and has to retrace his steps with the scenery ignored and only discomfort to replace it. For all he cares now the trees might be bare of leaves, the grass blackened by fire, the sky threatening. But listened to out of context, it is all lovely sound.

The Finale has a wallop that leaves the mind and emotions sprawling. It opens in an atmosphere of toe-curling horror. To fear is added hopelessness and agony. It is the dirty pain of an incurable affliction. Kubelik steers carefully between grovelling self-pity and the kind of fist-shaking defiance that Beethoven could carry off so well. Kubelik humanises it, with all the weaknesses and strengths that this cant term describes. He makes decorous a pain-laden experience such as watching a fellow-human suffering with the power to alleviate his agony. One doesn't emerge from the experience without embarrassment — such raw wounds should be covered and not flaunted like banners. But he batters his way through your defences of repulsion at such self-exposure. Some of it is almost unbearingly beautiful, beautiful enough to bring one nearly to tears. Indeed Kubelik and his fine orchestra make a work, that is far from one of my favourites, come as close to a totally enjoyable experience as I've ever heard it.

★ ★ ★

PUCCINI—Manon Lescaut. Complete opera. Licia Albanese; Jussi Bjorling; Robert Merrill, with the Rome Opera House Chorus and Orchestra conducted by Jonel Perlea. RCA Victrola Mono VIC-6027/8.

This re-issue at reduced price of a set first put out some 12 years ago is well worth examination, since the only alternative I know of is the old Seraphim-Columbia which must be nearly the same age. Moreover, though it was originally issued on three discs, as was the Columbia, it has now been got on to two without loss of definition. It has Bjorling in one of his best performances, passionately lyrical and strongly dramatic, and Robert Merrill as a fine Lescaut. Albanese makes a good Manon, perhaps not quite so youthful-sounding as might be hoped, but excellent in characterisation. Perlea conducts admirably but the sound is, of course, somewhat deficient by more modern standards. The whole performance is probably the best obtainable nowadays, no matter what price you may have to pay for others. But the set also makes the point that a really good new recording of this quite beautiful early work of Puccini is very much overdue. It is full of ravishing melodies and it shows, even at the time it was written, back in 1892, much ingenuity in the use of the orchestra. But, as was the case in Otello, there is a little fanfare that I listened for eagerly, but I was unable to hear anything but a faint ghost of the expected sound. I refer to the trumpet counter-theme when the coach leaves at the end of Act 1.

MOZART—String Quartet in D Major (K.499). String Quartet in B Flat Major (K.589). Amadeus Quartet. DGG Stereo. 139355.

I listened to these two quartets after a session with Hindemith's Cardillac reviewed above, and must confess to having found the relief heavenly. I don't know where you will hear lovelier Mozart playing than you have here. Some might think the legato phrasing in the Menuetto of D Major a little excessive, a shade too ingratiating. So what! I thought both performances utterly delicious. Here is music to tranquillise you, whatever your mood, without pharmaceutical aid. The Amadeus' tone is rich yet never too voluptuous for music of this period. The balance is always first rate, the recording faultless. I can strongly recommend the disc as one of the finest of its kind I have ever listened to.

Philips issued the same coupling played by the Netherlands String Quartet back in the early 1950s. It was good of its kind but is nowadays not in the running with this new DGG.

★ ★ ★

BERLIOZ—Te Deum. Franco Tagliavini; the Wandsworth Schoolboys' Choir; the London Symphony Orchestra and Chorus with Nicolas Kynaston (organ) conducted by Colin Davis. Philips Stereo SAL3724.

Philips continue their recording of the complete works of Hector Berlioz conducted by Colin Davis with his Te Deum. Right away I might say that this new issue maintains the very high standard set by the previous recordings in this series. The Te Deum is more than welcome since it was high time that another, new recording of this great work was made available in recorded form. The only other copy I have owned for many years is the old Beecham version, recorded many, many years ago with sound that might with the utmost kindness be described as senescent. The sound in the new one is superbly spacious and rich in detail.

Berlioz rearranged the liturgical order of the verses of the Te Deum for dramatic effect which was completely justified. He also added a Prelude and March for the Presentation of the Colours, both of which have been omitted, without to my mind, any loss, from the present recorded version. It is strange how the character of the Te Deum has changed over the years. In medieval times it was sung in times of national disaster. Nowadays — I am not sure nor can I confirm when the change took place—it is used to celebrate national victories and other occasions for thanks to God. It was, of course, in the latter sense that Berlioz composed his Te Deum. Another minor point of interest might lie in the fact that, in the old Beecham recording I still have, the solo organist — Berlioz contrasts the tone of organ and orchestra frequently throughout the work — was the now well-known Australian conductor and music scholar Denis Vaughan.

In Davis' performance he is Nicolas Kynaston. The tenor, Franco Tagliavini was an excellent choice for the solo part. He sings very enjoyably indeed using a neutral style, neither Italian operatic nor English oratorio, that suits the music admirably. I haven't the space, nor do I think you would like to be burdened with a parsing and analysis of Berlioz's great work. Briefly it is in six movements—Te Deum Laudemus; Tibi Omnes; Dignare; Christe Rex Gloriae; Te Ergo Quaesumus and Judex Crederis. No praise could be too high for the magnificent playing and sense of style of the London Symphony under Davis and the singing of the choir makes an altogether generous contribution to the success of this fine disc. The climaxes are huge and finely distributed, the quieter moments completely audible without adjustment of the volume control. If a tiny bit more could have been desired from the male choristers, well, that is, to me, the only small blemish on an otherwise memorable performance and recording.

★ ★ ★

SCHUMANN—Cello Concerto.
SAINT-SAENS—Cello Concerto.
Jacqueline du Pre and the New Philharmonia Orchestra conducted by Daniel Barenboim. HMV Stereo. OASD2498.

The Schumann Cello Concerto is a reflective type of work without very much push. Miss du Pre plays it with fine tone, but, eloquent though her performance is, it is not quite successful in knitting together a work which, with considerable justification, has been described as rambling. Neither the composer, nor the conductor, in this case husband Daniel Barenboim, can offer much to the soloist in the way of encouragement. Indeed it must have taken a notable and meritorious effort of concentration on the part of Miss du Pre to hold both her own and her audience's attention as successfully as she has managed to do here. When my attention tended to wander some striking bit of playing by the soloist always recaptured it. The orchestration is so lacking in distinction that HMV's first class sound cannot do very much for it.

After the Schumann, the Saint-Saens, though of no great stature, has a champagne-like quality. It is consistently melodious wrought with the composer's customary elegance of workmanship. Every bar is eminently "listenable" if you will pardon a clumsy neologism. Neither Miss du Pre nor Barenboim cheapen the work by sentimentalising it. Neither do they try to make it sound more important than it really is. It is unpretentious but by no means trivial and I found it all unremittingly charming. The sleeve notes by Frank Hampson mention that Saint-Saens defended polemically "the new music of Liszt, Berlioz and Wagner" but fail to qualify this by recalling that during World War I Saint-Saens chauvinistically led a movement to prohibit the playing of Wagner's music anywhere in France.

★ ★ ★

CHOPIN—Piano Concerto No. 1 in E Minor.
LISZT — Piano Concerto No. 1 in E Flat Major.
Martha Argerich and the London Symphony Orchestra conducted by Claudio Abbado.
DGG Stereo, 139383.

I first met Martha Argerich last month on a musicassette in an excellent performance of concertos by Ravel and Prokofieff. This is the first

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disc of her playing I have heard. From the sleeve notes I find that she is Argentinian and the 1965 Warsaw Chopin Prize Winner. With the latter fact in mind, it is a little surprising to hear her giving the highly individual performance of the Chopin that is offered on this record. Very often she treats the composer's markings with scant attention. Her rubatos are overdone by modern standards — imposed instead of felt. This is especially noticeable in the first movement. The slow movement, though conforming more to customary Chopin style, is her least interesting. What I have written might give you the idea that the whole performance is something of a write-off. On the contrary, with all its faults, it is a gallant interpretation presented with dazzingly technical skill.

It is so odd that I might even grow to like it. The sound is good, though I cannot describe the LSO as being at their best under Abbado.

If I used the word gallant to describe Miss Argerich's performance of the Chopin, swashbuckling would suit her performance of the Liszt. She takes some of the fast passages at such a pace that she makes the runs sound like harp glissandos. And this she manages without any sense of slurring. She never loses her hold on the concerto's facile poetry. A most exciting performance. The sound in this, too, is excellent, but if you're listening for the famous triangle notes you'll hear only a mosquito-powered tinkle so far away that it's impossible to make out the rhythm of the notes.

★ ★ ★

STRAUSS (Richard)—Till Eulenspiegel's Merry Pranks. Death and Transfiguration. Dance of the Seven Veils from Salome. Vienna Philharmonic Orchestra conducted by Herbert von Karajan. Ace of Diamonds Stereo SDD211.

When the recording of this recital was first issued back in 1961 critics and hi-fi enthusiasts hailed it as a masterpiece of record making. It is now re-issued on a cheap label and still sounds very good indeed, if not quite up to the best of the more recent exercises in stereo. The performances are first rate. Death and Transfiguration still works — on me, at any rate — and Till confirms the opinion that it is one of the two best of Strauss' symphonic poems. The other, of course, is his Don Quixote. There is no trace of vulgarisation of either of the two works in which even the Transfiguration theme is made to sound stately.

The Salome Dance is very excitingly and voluptuously played. If you have not worn out your response to early Strauss this is a very good buy at the price.

★ ★ ★

HENZE — Violin Concerto. Wolfgang Schneiderhan and the Bavarian Radio Symphony Orchestra conducted by Hans Werner Henze. Ode to the West Wind for Cello and Orchestra with Siegfried Palm (cello) and the Bavarian Radio Symphony Orchestra under Henze. DGG Stereo 139382.

The violin concerto composed in 1948 will be fairly straightforward going to those who know their way around 12-tone territory. Schneiderhan's smallish, sweet tone dominates the solo part of quite extraordinary difficulty without a faltering bar. The concerto's construction, especially the scoring, is astonishingly mature for a 21-year-old composer and the fact that influences of Hindemith and Stravinsky can be noticed in no way impairs its impact. Although Henze uses a very large orchestra some of the scoring is of beguiling fragility, its transparency owing something to Mahler though without deliberate imitation of that composer.

As the sleeve notes point out you won't get very far with The Ode to the West Wind (1953) without the aid of a full score. A reduction to piano transcription would, of necessity, have to omit many of its intricacies — and refinements. It is a work of subtle nuances rather than violent contrasts. In this work too, the soloist, Siegfried Palm, whose part though again of towering difficulty, is an integral part of the structure rather than a virtuoso display, shows complete mastery of his instrument. The recording of both works is always impressively clear and well balanced.

★ ★ ★

SATIE—Parade Ballet. Relache Ballet. Gymnopedies Nos. 1 and 3 orchestrated by Debussy. Paris Conservatoire Orchestra conducted by Louis Auricombe. World Record Club S/6330.

The World Record Club often earns our deep gratitude for issuing at a club price interesting works unobtainable on more expensive labels. Erik Satie is nowadays better known for his verbal witticisms than his musical ones. Both the ballets offered here are well worth the modest outlay asked for them Both are typical of the spirit of French music at the beginning of the 1920s. The stories of the ballets are related in full in the sleeve notes so that you will find no difficulty in following the argument of the graphically illustrative music. You will also learn from the same sleeve notes about the many very funny things that happened during the first production of Relache.

Under Louis Auricombe the Paris Conservatoire Orchestra play with a verve and sensibility you'd be very lucky indeed to hear from them in Paris. And the two gymnopedies in their Debussy transcriptions for orchestra are delivered here with a refinement I've never heard before. The sound is first rate. So good that you can even hear the typewriter distinctly in Parade. Strongly recommended to all those interested in French music of the period.

★ ★ ★

HANDEL — Music For The Royal Fireworks. The Menuhin Festival Orchestra conducted by Yehudi Menuhin. H.M.V. Stereo OASD-2485.

Many years ago, when Charles Mackerras recorded this music for Pye, he had to play the sessions after midnight because it was only at that hour that he could get together enough oboes in London. Earlier they had been playing at other jobs. The result was one of the most exciting aural experiences ever produced on disc. Mackerras used 26 oboes, 14 bassoons, four contra-bassoons, two serpents, nine trumpets, nine horns, three tympanists and six side drums. Although there is still some doubt as whether or not Handel used strings for the original performance, Mackerras opted for his wind version. In this new issue Menuhin adds strings so that the orchestral colour is neither as distinctive nor as startling as in the earlier disc but it is still an eminently good performance admirably recorded. And since the earlier Pye disc nowadays can only be found in a second-hand shop—if you're lucky—this new account might well prove the most viable alternative.

From Paul Frolich . . .

SCHUBERT: Symphony No. 9 in C major, "The Great." The Philadelphia Orchestra, conductor Eugene Ormandy. CBS stereo SBR 235318.

This must have been one of the last recordings Ormandy taped for Columbia; it was a worthy effort and, at the same time, is strong evidence of Ormandy's, and his orchestra's, leanings towards the safety of standard works with spectacular sound.

Although this Schubert symphony is not counted among the more controversial orchestral works, it doesn't always come off. On record, we've had a glorious performance directed by Bruno Walter, two dreadful ones from Toscanini and a number of variously successful ones under Barbirolli, Bohm, Kertesz, Krips and Szell. Although there will be many, I expect, who will dislike Ormandy's interpretation as much as I did, his approach to the work commands respect and he brings to the score a firm point of view and clear ideas.

Schubert's music does not easily fit into any mould of formality and it is, historically, in a direct line from Mozart and Haydn. There is, in fact, a lot of Haydn in Schubert's orchestral scores and it is this element of his music which Ormandy wholly neglects and denies.

Ormandy's Schubert is indeed, a composer wholly of the romantic 19th century, with big ideas and a lushly orchestrated score. Ormandy's Schubert is, as becomes evident, the kind of composer fit to write for the highly polished and accomplished Philadelphia Orchestra—the Big Band to end all Big Bands! There are strong arguments on their side too: beautiful playing from all sections (though their string tone is just TOO silky for my digestion), a marvellous recorded sound and firm, intelligent direction from Ormandy. Don't be misled by my apparent crabbiness into thinking this a poor offering: far from it—if anything it is too rich!

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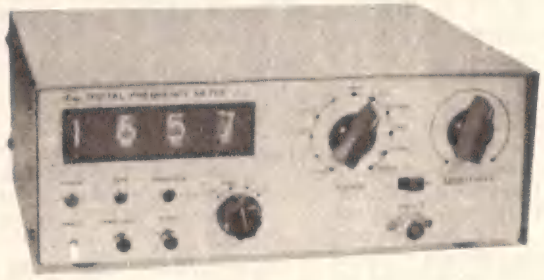

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VARIETY FAIR

By HARRY TYRER, FORBES CAMERON, NEVILLE WILLIAMS

Devotional recordings

THE CRUCIFIXION (Stainer). Eric Chadwick, organ; Alexander Young, Tenor; Donald Bell, bass; The Leeds Philharmonic Choir conducted by Herber Bardgett, O.B.E. Stereo, World Record Club S/4618.

Interest: Well known oratorio.
Performance: Very satisfying.
Quality: Good.
Stereo: Good spread.

While traditionally performed at Easter, Stainer's Crucifixion can be a moving experience at any time for those who respond to its inspirational message.

This particular performance is by no means recent and a check through the files revealed that I reviewed the mono release on the HMV label (OALP 1885) in March, 1963. This stereo version from the World Record Club offers a dimension missing from the mono pressing and one can now appreciate the spread of the voices and the separate sounds and echoes from the pipe ranks. As indicated in the earlier review, the recording is complete except for the omission of two congregational hymns. Other remarks in the review apply now, as then:

"Under Herbert Bardgett, now deceased, soloist, organist and choir acquit themselves very well indeed. The soloists, in fine voice, sing competently and without affectation, achieving acceptable diction without appearing to strive for it.

"The organ support is excellent and the choir, for the most part, suitably responsive to the conductor and to the music itself.

"The record could be studied to advantage by groups planning to perform the work, while it is eminently suitable for amplification in churches during the Easter season.

"Technically, this disc is of a high standard with a commendable lack of amplifier and/or tape hiss. In short, if you have a place in your library for 'The Crucifixion,' this is a good one." (W.N.W.).

★ ★ ★

HERE'S VONDA KAY. Stereo, Word WST-8464-LP. (Available from Sacred Productions Aust. 181 Clarence St. Sydney).

Interest: Tuneful, modern Gospel.
Performance: Sincere, capable.
Quality: Very clean.
Stereo: Nicely spread.

As the jacket notes indicate, Vonda Kay Van Dyke is quite a girl. On stage she is a gifted speaker, a gifted singer and an outstanding ventriloquist. She has appeared in several films and is a qualified private pilot. And, to cap it, she carried off the title of Miss America a few years ago.

On the "Miss America Pageant" on television, Vonda Kay testified powerfully to her personal faith in God. There is nothing artificial about her presentation of these modern Gospel songs, for they express her own personal convictions. In fact, the combination of the artist Vonda Kay, the compositions of Gospel writers Carmichael-Kaiser-Anka, and the arrangements of Bobby Gosh add up to a quite outstanding album. The songs:

Master Designer — A New World You Say — I Looked For Love — Pass It On — The Cray World — Keep Me Where Love Is — A Quiet Place — Reach Up For The Real Life — That's The Way It Is — There's More To Life — You Make My Day — It's Free.

This is an album that is designed for the young world but with plenty of rhythm and melody to appeal to their parents. Recommended. (W.N.W.).

★ ★ ★

THE GOSPEL TRUTH. Joe and Eddie Chambers. Stereo, Crescendo (Festival) SGNPL-933595. Also in mono GNPL-33595.

Interest: Gospel Jazz.
Performance: Dynamic plus.
Quality: Good.
Stereo: Normal.

Joe and Eddie were a couple of negro kids singing in the choir of the Presbyterian church at Berkeley, California, and in the a capella choir at the Willard Junior High School. But Dr Earl Blakeslee, leader of the High school choir, spotted their special talents and set in motion events which led to television and stage bookings. Their promising career as duo vocalists was cut short in 1966, when Joe was killed in an auto accident.

Their presentation, by their own definition, is Gospel-jazz and to my non-jazz-expert ears, they must rate as a couple of very proficient performers in this field. And I think that support for this album will come primarily from that field. While the titles are well known for their Gospel content, the style is far too way out for the average Gospel listener:

Swing Down, Chariot — Michael, Row The Boat Ashore — Children Go — He's Got The Whole World In His Hands — I Got Shoes — Down By The Riverside — When The Saints Go Marching In — Joshua — Gonna Be Singin' In That Land — There's A Meeting Here Tonight — Go Tell It On The Mountain — Sing Hallelujah — Didn't It Rain.

With jazz and possible youth appeal, it is nevertheless one that you will have to judge for yourself. Don't buy it unheard. (W.N.W.).

Instrumental, Vocal and Humour . . .

DIE DREIGROSCHEN OPER (The Threepenny Opera) with music by Kurt Weill to a text by Berthold Brecht. Studio performance of the complete work. Polydor stereo, 109 531-2-3 (three record boxed set). Available only against special import.

Interest: German musical.
Performance: Splendidly realised.
Quality: First class.
Stereo: Expertly done.

This is really not an opera at all, but a musical play, based on the eighteenth century "Beggar's Opera" of John Gay. The text was adapted by Brecht from a German translation of the original English version, but Weill's music owes nothing to its forerunner. Since its first performance in 1928 (it ran for five

years) it has been revived on numerous occasions. was staged in an English language version on Broadway in 1948 as "The Threepenny Opera" and was made into a film.

According to the brochure, which comes with this set, numerous records have been made of the show's musical numbers, but this is the first time that it has been presented on disc as a complete performance. (Complete should not be taken too literally, by the way, as there are numerous small cuts in the text, which makes it difficult to follow the complete printed German text provided with the set.)

This version has in the main roles Hannes Messemer as Mackie Messer (Mack the Knife); Karin Baal as Pollie Peachum; Helmut Qualtinger and Berta Drew as the elder Peachums; Martin Held as Tiger Brown. These and their supporting cast quickly establish and maintain, throughout, the sleazy underworld atmosphere in which the events take place. Characterisation has always preceded vocal ability in this work — in fact, the vocal numbers were deliberately made easy, so that the cast could be chosen for their acting ability, rather than their musical prowess — and in any case the musical numbers occupy little more than a quarter of the total playing time. Accordingly, one does not expect great vocal feats, but the cast here acquit themselves very creditably. As a first complete recording, then, this version should be welcomed by those with a taste for "The Threepenny Opera." A word of warning, though, to those who speak no German, or have only limited knowledge. No English translation is provided, and as I mentioned above, the occasional cuts are confusing when following the text provided.

The set is beautifully presented in a hessian covered box, with a large-format illustrated brochure giving details of the work's history, previous performances on stage and disc and short biography of the creators. It should give a lot of pleasure to a particular group of people. (H.A.T.)

★ ★ ★

THE IMMORTAL WORKS OF KETELBY. The Royal Philharmonic Orchestra and Chorus, conducted by Eric Rogers. Decca Phase Four Stereo (E.M.I.) PFS 4170.

Interest: Persian Market, etc.
Performance: Fine.
Quality: High standard.
Stereo: Well spread.

Detractors of Ketelby sneer at his music as though they expect it to stand comparison with Beethoven and Wagner. This has about as much sense as expecting the nonsense verse of Edward Lear to stand comparison with Shakespearean masterpieces. In their own class, each has a high rating, and as light music these charming and tuneful miniatures will always give pleasure to those prepared to accept them for what they are. In any case, there are some delightful melodies — the Princess music from "In a Persian Market" for example — which will ensure the survival of these pieces in the light music field.

Having got that off my chest, I will now turn to the disc which inspired the remarks. The tracks are just what one would expect: In a Monastery Garden — Wedgwood Blue — In the Mystic Land of Egypt — Bells Across the

Meadow — In a Chinese Temple Garden — The Sanctuary of the Heart — 'Appy 'Ampstead — the Phantom Melody. — In a Persian Market. Recorded in Decca's Phase Four Stereo system, noted for its brilliance and realism, by the Royal Philharmonic Orchestra and 30-voice male chorus, this disc has just about everything going for it. However, I must report being very slightly disappointed by the interpretation. In my opinion this type of music can stand any amount of schmaltz, and this performance seemed just a little bit too matter-of-fact. However, I hasten to add that this was only a slight reaction which was far outweighed by the pleasure I obtained from hearing these pleasing melodies expertly played and recorded superbly by Decca. (H.A.T.)

★ ★ ★

THE WORLD'S MOST GLORIOUS MELODIES. Reginald Kilby and His Strings. Columbia Studio 2 Stereo (E.M.I.) TWO 276.

Interest: Light classics.
Performance: Virtually faultless.
Quality: Fine warm tone.
Stereo: Good balance and spread.

Since I reviewed Volume 1 in this series (there could well be more to follow) I knew just what to expect. The fine warm tone of the all-string orchestra enhanced by the near ideal acoustic of the St. Augustine's Church, Maida Vale (near London), the careful selection of beautiful melodies — these all add up a most enjoyable musical experience for those who find pleasure in light classics. The tunes are: Melody in F (Rubinstein)—Songs My Mother Taught Me (Dvorak) — Panis Angelicus (Franck) — Cavatina (Raff) — Barcarolle (Offenbach) — Chanson Triste (Tchaikowsky)—Plaisir D'Amour (Martini) — Traumerei (Schumann) — What is Life, from "Orpheus" (Gluck) — Poem (Fibich) — Pantomime, from "Zemire er Azor (Gretry) — Waltz in C sharp minor (Chopin). Recorded in Columbia's Studio 2 Stereo system, the disc is technically all one could ask. Recommended for light classics buyers. (H.A.T.)

★ ★ ★

SYMPHONIC TANGOS. Leon Pops Orchestra. Stereo, Calendar SR66-99677.

Interest: Pleasant sound.
Performance: Capable musicians.
Quality: Very clean.
Stereo: Nicely spread.

When they first appeared on the local scene a few years back, released through Festival, albums from King Records, Japan, made quite an impression. Not only was the playing itself right up to the standards of "western" orchestras, but the recording quality was well above average.

This re-release on the economy Calendar label gives you the chance of adding to your library a typical example of the King Records sound. The tangos featured include: La Cumparsita — Jalousie — Perlenfischer — Dream Tango — A Garden Of Italy — Il Pleut Sur la Route — Hor Mein Lied Violetta — Blue Tango — Isle Of Capri — I Kiss Your Hand, Madam — Tango Delle Rose — Blauer Himmel.

The tempo may be a little too strict and the playing a little too stylised to play the whole album at once, but certainly pleasant a few tracks at a time. (W.N.W.)

Reader's Digest Album

SOUTH SEA ISLAND MAGIC. Stereo, Reader's Digest 6-record set in attractively illustrated box.

Interest: All around the Pacific.
Performance: Smooth and romantic, as you would expect.
Quality: Very clean.
Stereo: Beautifully spread.

Having wandered along the beach at Waikiki, having sampled the heavily organised pleasures of Hawaii, and relaxed in the balmy Fijian night air to the sound of a native orchestra, I'm rather responsive to island music. But I must confess that the prospect of 12 sides of Leilani and Hula Hands rather daunted me — as might a full meal of trifle!

However, Reader's Digest have attempted to broaden the vista and, while the set goes under the name of "South Sea Island Magic," they've contrived something more like a sonic tour of the Pacific, with a couple of other oceans thrown in for good measure. Perhaps it's just as well they overlooked Australia, otherwise we might have had balmy, steel guitar version of "Waltzing Matilda."

The six records are arranged so that, if stacked on an automatic player, the sequence of sides will conform to the Editor's suggestion as to how they should be played. There are far too many individual titles to list them all — actually about six per side — but they are listed on the jackets along with orchestra and artists, and the background of the particular numbers.

Here's how the sequencing goes: 1. "Hawaii Calls" — traditional island sound; 2. "On the Beach at Waikiki" — more island sound; 3. "Quiet Village" — ranging to Fiji and the land of the Maoris; 4. "A Song of Old Hawaii" — still not too far from Hawaii; 5. "Treasure Island" — some recruited tunes, including "Bali Hai," and "Born Free"; 6. "Exotica" — really going places, with the RCA Victor Symphony Orchestra and ports as far apart as India, Brazil and Heaven. 7. "Paradise Island"—touring hither and yon with Douglas Gamley and his Orchestra, including a visit to that devotional site "Beautiful Isle of Somewhere." 8. "Hawaiian War Chant"—not as grim as it sounds; 9. "Adventures in Paradise"—around the Pacific Scene with Gardner McKay of television fame; 10. "Pacific Panorama" — from Macao and Hong Kong back to Diamond Head, pausing for a "Kiss in the Shadow" from "The King And I." 11. "Ebb Tide" — back again with the Kalua Beach Boys; 12. "To You, Sweetheart, Aloha"— a sentimental farewell.

If I've managed to convey some idea of what the set is all about, and the idea appeals to you, there is certainly no need for caution about the quality of the records in a technical sense. I listened to or sampled most tracks, without hearing any trace of distortion or noise.

If you can't afford a Pacific cruise, pull up a deck chair and let the Beach Boys, The Islanders, Johnny Gibbs, and others, lull you into a South Sea Island slumber — free of Nandi's man-eating mosquitoes. (W.N.W.)

FANTASTIC CUBA. The Tokyo Cuban Boys. Calendar (Festival) stereo SR66-99,678.

Interest: Popular rhumbas.
Performance: Excellent.
Quality: Excellent.
Stereo: Well spread.

I have previously commented on the excellent playing of the Tokyo Cuban Boys. Don't think that these Japanese musicians cannot compare with western groups — they are very good indeed, and they seem to have a particular affinity for Latin American and Spanish music. I could find little to complain about here. A slightly jarring note is their tendency to play a short preludic passage to most numbers, which is quite inappropriate to such numbers as "Tico Tico" where the main tune should be launched into right at the start, but on the other hand the oboe solo which precedes Lecuono's "Andalusia" is very effective. A particularly good track is a rendering of "Cumana" which features a dialogue between piano and marimbas, the musicianship of both performers being outstanding. Also included are: The Carioca — Oye Negra — Miami Beach Rhumba — Estrellita — Mama Inez — La Comparso — Besame Mucho — Begin the Beguine. Excellent for dancing, and good listening for wallflowers. (H.A.T.)

ORIGINAL GOLDEN HITS, Vol. 2. Johnny Cash and the Tennessee Two. Calendar (Festival) stereo SR66-9740 Available in mono.

Interest: Veteran C. and W. singer.
Performance: Top ranking.
Quality: Satisfactory.
Stereo: Mainly centre channel.

One of the best C. and W. singers of today, Johnny Cash has a long career behind him, so that there is plenty of material to chose from in presenting his best tracks. Presumably that is why it has been thought necessary to present it in two volumes. The special qualities I associate with his style are integrity and sincerity — qualities which are rare in the commercialised Nashville set-up of today. If you like his style, this disc, (and no doubt its companion Volume 1 which I have not seen) will be especially welcome at the Calendar price ($2.95). There are 11 tracks: Ballad of the Teen-age Queen — Come in Stranger — The Ways of a Woman in Love — You're the Nearest Thing to Heaven — I Just Thought You'd Like to Know — Give My Love to Rose — Guess Things Happen that Way — Just About Time — Luther Played the Boogie — Thanks a Lot — Big River. Johnny has the usual two female vocalists supporting him in this disc, but their contribution is minimal, and he dominates the performance. In the stereo spread he is firmly placed in the centre. (H.A.T.)

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More Moog music

COUNTRY MOOG: SWITCHED ON NASHVILLE. Gil Trythall on the Moog Synthesiser. Athena Records (Festival) stereo SFL-933660. Available in mono.

Interest: C. and W. on Moog.
Performance: An outstanding success.
Quality: Excellent.
Stereo: Carefully arranged.

Most Moog synthesiser discs since "Switched on Bach" have failed to impress because the arrangers have tried to take short cuts and have not built up their harmonic structures and counterpoint in the way which Walter Carlos did with his Bach disc and its successor "The Well Tempered Synthesiser." Now at last somebody else has realised that this kind of treatment is essential for a successful Moog performance. This disc is an absolute winner which deserves to become in the popular field what "Switched on Bach" has become in the classical field. It features country and western standards, but you have never heard them sound like this.

To my mind the outstanding track is "Folsom Prison Blues," with its imitation of a deep voiced, nasally C. and W. singer (could Johnny Cash have been in mind) which is quite startling in its intonation and pronunciations of recognisable words in places. An exciting pace is maintained all through "Foggy Mountain Breakdown," while "Last Date" has a soulful "harmonica" solo. Each track is different, but each one is as interesting in its own way as all the others. Besides the above-mentioned tunes, there are: Harper Valley P.T.A. — Cattle Call — Gentle on my Mind — Wildwood Flower — Orange Blossom Special — Walking the Floor over You — Little Green Apples —Yaketty Moog. The recording is of excellent quality, and the "instruments" have been carefully arranged across the stereo spectrum to heighten the effect of group playing. If you have been put off Moog synthesiser discs by inferior material put out since "Switched on Bach" don't let that deter you from this very enjoyable disc. (H.A.T.)

★ ★ ★

MOOG ESPANA. Arranged and conducted by Sid Bass. Stereo, RCA Victor LSP-4195.

Interest: Moog in orchestra.
Performance: Easy on the ear.
Quality: Very clean.
Stereo: Normal.

We've had arresting Moog, tedious Moog, amusing Moog; some of it successful, some of it not likely to be.

For this Victor album, Sid Bass began by laying down a foundation of rhythm involving six instruments, and some melodic backing involving four trombones. Then he repaired to the Moog to add a variety of new sound, some of it way out, but most of it not strange to ears accustomed to the effects which are now commonplace in electronic organs.

The result is an album with a "different" sound about it but strongly Spanish in character, and tuneful. The numbers contribute strongly to this atmosphere: Espana Cani — Playera — Granada — Mantilla — Mama Inez — Malaguena — Spanish Flea — Lady Of Spain — Valencia — The Peanut Vendor — Ritual Fire Dance — El Amor Brujo.

A good one for the collector who would like a Moog album, but not too Moog! (W.N.W.)

THE HARMONIOUS BLACKSMITH. A collection of Harpsichord encores. Igor Kipnis. C.B.S. stereo SBR235354.

Interest: Early keyboard music.
Performance: Delightful.
Quality: Fine recording.
Stereo: Not significant.

Harpsichord music is an acquired taste. As one who has progressed through the stages of curiosity, initial disappointment, awakening interest, enthusiasm and finally overwhelming preference for hearing early keyboard music played on the instrument it was written for, I can assure those as yet in the first stage mentioned above that it pays to persevere in this matter. And for these people I can think of no better disc to start on than this one. Not only is Igor Kipnis a brilliant performer, exhibiting wonderful control and superb finger technique, but he has chosen a delightful program (and a very long one too) for this disc. Among the 23 pieces included are such favourites as Handel's "Harmonious Blacksmith" variations — Greensleeves — Jeremiah Clarkes "Prince of Denmark" March (better known as "Trumpet Voluntary") — Le Tic-Toc-Choc (Couperin) — Solfeggio in C Minor (C.P.E. Bach) — Rondo Alla Turca (Mozart) — Minuet in G (Beethoven) — and many similar works.

I take the instrument to be a fairly modern one, and I must say that I find the tone a little light for my taste. I much prefer the bigger-toned instruments used by the late Wanda Landowska. Apart from this minor quibble, I found the program entirely delightful. Particular care seems to have been taken during the recording to avoid including the mechanical noise of the instrument which has been quite prominent in some harpsichord recordings. Highly recommended. (H.A.T.)

★ ★ ★

THE MUSIC OF THE MOUNTAINS. Manuel. World Record Club stereo S/4681.

Interest: Light music L.A. style.
Performance: Unexciting.
Quality: Dated.
Stereo: Restricted.

Despite the liberal use of the adjective "exciting" in the sleeve note, I cannot get very excited about this disc. It starts off well with a lively interpretation of "Mexican Hat Dance," and sounds quite pleasing for a few tracks, but after that the invariable style (all string orchestra with female choir "ahing" in the background) tends to become slightly tedious. The disc appears to date from about 10 years ago, and although the sound is clean, it lacks the brilliance of today's recordings. Dynamic range is restricted, likewise the stereo spread. As background music this could serve a useful purpose, but I

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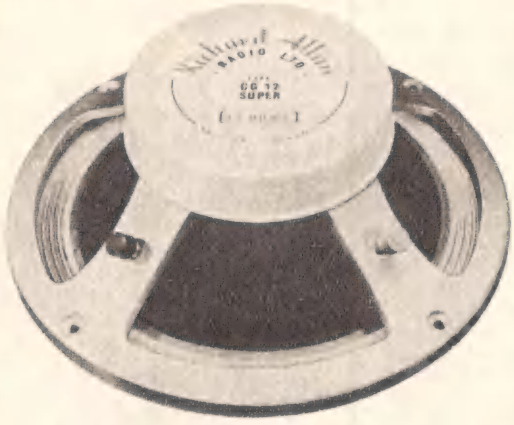

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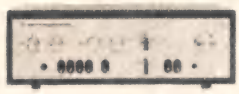

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★ ★ ★

SING ALONG AT THE TOWER. Reginald Dixon. Stereo, World Record Club W.R.C. S/4688.

Interest: Blackpool Community Sing.
Performance: Happy.
Quality: Clean but . . .
Stereo: Normal but . . .

Reginald Dixon and his "mighty Wurlitzer" in the Blackpool Tower are so well known and such an institution that further introduction would seem to be quite unnecessary.

As the title suggests, this album is one of those old-fashioned community singing sessions that used to be so popular on radio during the thirties. In fact, time would seem to have stood still, for the atmosphere, the numbers, the organ, in fact everything about the session belongs to the thirties.

Quality-wise, the sound is good and clean but the sheer size of the huge ballroom has played havoc with the timing. Reginald Dixon is well into each chorus before the audience gets going and at times they're best part of a beat behind. Acoustically it's a mess! But who cares about such details when everyone's having such a whale of a time?

Buy a copy for the old folks and watch them drift off into the land of nostalgia. (W.N.W.)

★ ★ ★

JOHN OGDON PLAYS POPULAR CHOPIN. His Master's Voice (E.M.I.) stereo HQS 1189.

Interest: As per title.
Performance: Slightly superficial.
Quality: Excellent.
Stereo: Not significant.

When I reviewed John Ogdon's recent "Popular Liszt" record two month's ago, I questioned the inclusion of some pieces under the "popular" title. I certainly have no such reservations here. Quite the reverse — most of the pieces here almost qualify for the unfortunate designation "hackneyed": Polonaises Nos. 3 in A major (Military) and 6 in A flat major (Heroic) — Nocturnes Nos. 2 in E flat major and 5 in F sharp major — Valses Nos. 6 in D flat major (Minute) and 7 in C sharp minor — Fantaisie Impromptu — Etudes Nos. 3 in E major (Tristesse) and 12 in C minor (Revolutionary) — Preludes Nos. 7 in A major and 15 in D flat major (Raindrop) — Mazurkas Nos. 5 in B flat major and 23 in D major — Ballade No. 1 in G minor. After the splendid playing found in the Liszt disc, I was slightly disappointed by Ogdon's performance here. There appears to be a hint of impatience in his playing, and I cannot help feeling that many items are too far below his standard for him to take them seriously.

Happily, there is still enough brilliant playing, such as in the "Revolutionary" study and the G minor Ballade, to make this disc a worthwhile proposition, particularly for those who limit their interest in Chopin to the better known pieces found here. (H.A.T.)

Ivan Rebroff . . . "unique"

IVAN REBROFF, with balalaika ensemble troika. C.B.S. (Australian Record Company) stereo SBR 235353.

Interest: Popular Russian songs.
Performance: Quite fantastic.
Quality: Excellent.
Stereo: Normal.

Ivan Rebroff, and his fantastic three-octave voice. will be better known now than when I discussed his first disc about two years ago. He has since appeared several times on television. However, in case you have not yet heard him sing, it is well to point out that his voice is quite unique in every sense of the word. He is a true basso, with a deep, rich and resonant voice, yet he can sing as high as top B flat, at the top of the soprano range. He can also sing any part in between. The amazing thing is that neither his bass voice nor his soprano voice sound the least bit strained. His pitch is unerring for the most part (there is a slight tendency to slide to the note at the top of the range) and he can execute a soprano trill very creditably. As I said. quite unique.

His first disc consisted entirely of Russian folk songs, of the type which would be virtually unknown outside Russia. This second recording features more popular numbers, and even includes "Lara's Theme," from Doctor Zhivago. The other tracks are: Evening Bells — Two Guitars — Dark Eyes — Songs of the Volga Boatman — The Nightingale — Volga Song — Meadowland — Bublitschki — Over the Steppes — Rapaschol. I personally found this program less interesting than the previous one, but it is still a very worthwhile one. Those who already have the first release will almost surely want this one. If you missed out first time round, the previous disc (Songs of Old Russia SBP 233452) can still be obtained from Australian Record Company. (H.A.T.)

THE MUSIC OF MEXICO. Various artists and orchestras. Capitol, Worldwide Series (E.M.I.) Stereo ST 21150.

Interest: As per title.
Performance: Bright and entertaining.
Quality: Good recording.
Stereo: Normal.

The music of Mexico has always been noted for its lively rhythmic character, so one is not surprised to find these qualities very evident in this latest release in the excellent Worldwide Series. As usual in this series, a number of different groups are featured, to give the program a pleasing variety. Thus, there are the typical Mariachi bands (the style which inspired the Tijuana Brass), small combinations, with or without vocalists, such as one might find in cantinas (the Mexican equivalent of the Australian pub); and the more sophisticated style of entertainment of the nightclub and dance hall. Noticeably absent is the music of the bullring, presumably because this has already been well covered by the Spanish disc.

Some of the numbers presented have achieved international fame, such as "El Rancho Grande" and "Frenesi," but in general the titles are unlikely to mean anything to the Australian listener. The same applies to the various band represented. For this reason, I do not propose to list either, but I can say that this is a most enjoyable disc, lively, entertaining and well up to the high standard set by previous discs in the Worldwide Series (H.AT.).

BUNCH-A-BANJOS ON BROADWAY. Freddy Morgan. Stereo, Sunset (Festival) SLS-96,059. Also in mono LS-6,059.

Interest: As per title.
Performance: Happy sound.
Quality: Clean.
Stereo: Normal.

A whole LP strongly featuring lead and support banjos may not be to everybody's liking but there is no gainsaying that it is a happy sound; one that goes naturally with smiling faces and tapping toes. And, of course, the "Broadway" music helps: Give My Regards To Old Broadway — Mame — Hey, Look Me Over — Cabaret — Heart — The Surrey With The Fringe On Top — Once In Love With Amy — You're Just In Love — Wouldn't It Be Loverly — Hello Dolly — Happy Talk — There's No Business Like Show Business.

The quality is very clean and it's the sort of sound that you can intersperse with other music, a couple of tracks at a time. The playing time of 28 minutes is not generous but, at the Sunset price, it's fair enough value. (W.N.W.).

★ ★ ★

A.B.C. HOSPITAL HOUR PROGRAM, Featuring Helen Zerefos, Ronald Maconaghie and the Orchestra. Stereo, Festival SFL-933,671. Also in mono FL-33,671.

Interest: Established favourites.
Performance: Vital, fresh.
Quality: Very clean.
Stereo: Nicely spread.

Recording companies have thought up all manner of gimmicks to select and relate the tracks on long-playing albums, some of them far from convincing. Festival have come up with a good idea here, however, in using the A.B.C.'s always-popular "Hospital Hour" as an index to the likes and dislikes of a particular audience.

Host Garry Ord merely introduces the disc but thereafter it is over to stage and television stars Helen Zerefos ("Say It With Music," "Sound Of Music") and Ronald Maconaghie ("The Magic Of Music"). And a very enjoyable program they provide: Sound of Music — Love Is Blue — The Donkey Serenade — The Wedding — Theme From Peyton Place — The Northern Lights Of Old Aberdeen — Goodbye — I Could Have Danced All Night — Lara's Theme From Doctor Zhivago — Galway Bay — Puppet On A String— Swedish Rhapsody.

A very pleasant local production. The playing time: 33 minutes. (W.N.W.)

★ ★ ★

FOR TOMORROW. The Kinsfolk. Camden (RCA) stereo CAMS-151.

Interest: Australian folk group.
Performance: Pleasant enough.
Quality: Very good.
Stereo: Normal.

The sleeve note talks about the Kinsfolk as though everybody should know about them. I didn't, nor did anybody else I asked, including those who know just about everybody in the folk singing field. It appears that this three men and a girl team (shades of the Seekers) is an all-Australian group, and that they have been abroad; perhaps they are better known overseas. As a group they are pleasant to listen to; their voices blend harmoniously, and their

VOICES OF HISTORY. Excerpts from speeches by American Presidents since 1933, and Sir Winston Churchill. Sunset (Festival) stereo SUS-96,072. Available in mono.

Interest: See above.
Quality: See review.
Stereo: Not significant.

"Voices of American History" might have been a more appropriate title, since, except for two brief excerpts from Winston Churchill's wartime speeches, the disc is devoted to speeches by the American Presidents, from Roosevelt's inauguration speech following his election in 1933 to L. B. Johnson's address to Congress after President Kennedy's assassination in 1963. The larger part of the disc is taken up by inaugural addresses, and while these may be of absorbing interest to Americans, I cannot believe they will have the same appeal to Australians. The remaining items are more interesting. Apart from the Churchill excerpts, which include his "Finest Hour" speech from embattled Britain in 1940, and his address to Congress following the attack by Japan on America in 1941 there is General MacArthur's speech to Congress following his dismissal by Truman in 1951, and President Kennedy's Cuba speech of 1962.

The sound quality of the first part of the disc is very poor, as recording techniques at the time were far below what we take for granted today under even the most difficult conditions. The gradual improvement as the disc progresses is interesting in itself, as a demonstration of the progress in recording techniques over the period in question. Those who gave the disc a miss on its first release at $5.75 a few years ago might be more tempted by its re-issue price of $2.95. (H.A.T.).

★ ★ ★

SIGN ON WITH CAPTAIN COOK. A musical play for children about Captain Cook's voyage. Compatible stereo, Music For Pleasure MFP A-8111.

Interest: As per title.
Quality: Very clean.
Performance: Adequate.
Stereo: Not important.

The now very familiar story of Captain Cook's first voyage of discovery is dramatised by well known radio actors Nigel Lovell, Ross Higgins and Reg Quartley, with Ray Hartley, Brendon Lunney and Joanne Neville.

A mixture of narration and drama, the album covers the early career of James Cook, his enlistment in the British Navy and his appointment to lead the now famous voyage of discovery. It follows the ship from England to Madeira, to Rio de Janeiro, around the Horn and on to the idyllic stay in Tahiti. Then to New Zealand and to the east coast of Australia, leading to the near loss of the ship on the Barrier Reef.

Cook's concern for his crew appears in sharp contrast to the inroads of disease encountered in Batavia, which brought Cook back to England a very saddened man.

With a playing time of about 47 minutes, this M.F.P. release is good value. having in mind its relevance to the current national celebrations. (W.N.W.)

guitar playing is accomplished. What the group appears to lack is a personality of its own — a strong voice to present the lyrics, as Judy Durham's did for the Seekers. With this I am sure they could go places. The 10 tracks they present here are: Coal Tattoo — Who is Why — Old Garden Shed — Hangman — Blind Man — I Knew a Man — Ainta That Good News — Bethnal Green — For Tomorrow — Best of Both Worlds. Mainly for the philosophical young, I feel. (H.A.T.)

★ ★ ★

HERE'S SANDY — Sandy Scott. Universal Record Club. Stereo U-1029.

Interest: Very popular Australian singer.
Performance: Representative.
Quality: Well recorded.
Stereo: Normal balance.

Sandy Scott is unquestionably the most popular entertainer in Australia today, well known throughout the country for his television, club and concert appearances.

Side One of the new Universal Record Club release was recorded "live" during club appearances and the tracks include "The Impossible Dream," "A Man and a Woman" and a medley of "In The Arms of Love" and "Can't Take My Eyes Off You." The sound, incidentally, on these location recordings is surprisingly good.

The six tracks on the second side are all studio recordings and they include "Red Roses," "24 Hours from Tulsa," "More" and "Spanish Eyes."

In short, this is an album fully representative of Sandy Scott's talents. At the bargain club price and with a playing-time of 33½ minutes, it should be an attractive purchase for Scott admirers. (T.F.C.)

★ ★ ★

GOLDEN HITS Part 2 — Dionne Warwick. Festival (Scepter) Stereo SJL933649 (also in mono).

Interest: Outstanding popular entertainer.
Performance: Mostly excellent.
Quality: Rather flat.
Stereo: Well balanced.

Volume 2 of Dionne Warwick's Golden Hits is just as strong and well-

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balanced as Volume 1. Miss Warwick clearly possesses the formula for success — recording first-rate and appealing songs, good arrangements and backings, a voice that adds a dimension to her material and that magic "star-quality" which only a handful of artists achieve.

All but two of the 12 songs on this LP are Burt Bacharach/Hal David compositions and they include huge Warwick successes like "I Say A Little Prayer," "San Jose," "Message to Michael," "Trains, Boats and Planes" and "What The World Needs Now." The pick of the other tracks are "Who Can I Turn To," "Unchained Melody" and "Windows of the World."

Although only half of the tracks were "hits" in the usual sense, the album is most enjoyable and should appeal to many readers who share my liking for Miss Warwick's singing. (T.F.C.)

★ ★ ★

CATERINA VALENTE LIVE. Decca (E.M.I., stereo SKLA 7661).

Interest: Popular entertainer on tour.
Performance: She wowed 'em.
Quality: Rather hard sound.
Stereo: Probably rigged.

Following her successes of some years ago, Caterina Valente has been disappointing in more recent records. This recording, taken "live" during a recent tour of Germany, shows that she can still command enthusiastic support from an audience. She only has to sing one bar for the applause to start, and as she goes through the medley of popular show tunes which begins this disc she has to sing through spasmodic applause at the beginning of each number. The aplomb with which she sails through the audience noise marks her as a very seasoned performer. She obviously enjoys singing to a live audience, and at times becomes almost carried away by her own boisterous spirit, giving a succession of high-spirited yells at the conclusion of some numbers as the audience thunders its approval.

Although, naturally enough, for a German audience, she sings a considerable amount of German material, she shows her multi-lingual talents by throwing in English, Italian and Portuguese numbers. The program comprises: Side 1; Musical Hit Parade Medley (including Hello Dolly — America — Maria — If I Were a Rich Man — Aquarius, and others); Italian Hit Parade (Volare — Nessuno al Mondo —Personality — Till); Latin Medley (Malaguena — The Breeze and I). Side 2; Falling in Love With Love — So Wie ein Riesenrad — The Windmills of Your Mind — Air Mail Special — Canto de Ossanha — Singing My Song. The sound is clean, but has a hard quality, and I suspect that the stereo spread was "arranged" after the event. (H.A.T.)

★ ★ ★

BOBBY GENTRY'S GREATEST HITS. Capitol (E.M.I.) stereo ST 21509.

Interest: Popular entertainer.
Performance: Style and personality.
Quality: Good standard.
Stereo: Normal.

It seems to me to be a bit pretentious to have a disc of "Greatest Hits" for somebody who has been on the entertainment scene for such a short time as Bobby Gentry. Certainly her "Ode to Billy Joe" and "I'll Never Fall in Love Again" achieved great success, but some of the other tracks could hardly qualify as "Hits." This is not to say that this is not a very enjoyable disc. A performer of Bobby's ability and personality is always good listening, and every track here is worth hearing. But let's forget the "Greatest Hits" bit.

What you get for your money are: Ode to Billy Joe—Mississippi Delta—Okolona River Bottom Band — Penduli Pendulum — Sweet Peeny — Tobacco Road — I'll Never Fall in Love Again — Ace Insurance Man — Touch 'em With Love — Glory Hallelujah How They'll Sing — Papa's Medicine Show — Sittin' Pretty — Eleanor Rigby — Fancy. Until such time as Bobby has been in the business long enough to warrant 12 tracks of "Greatest Hits" this selection is a pretty good stand-in. (H.A.T.)

★ ★ ★

FRANCOISE IN LOVE. Francoise Hardy. Vogue (Festival) stereo SVL-933,540. Available in mono.

Interest: Chansons d'amour.
Performance: Pensive.
Quality: Good standard.
Stereo: Normal.

This is, I believe, the sixth in the current set of Francoise Hardy releases from Festival, and it again has a program sung entirely in French. Mlle Francoise's view of love is apparently

For young listeners

PETER AND THE WOLF (Prokofiev) and the Young Person's Guide to the Orchestra (Britten) The Orchestre de Paris conducted by Igor Markevitch, Narration by Eric Porter. Studio 2 Stereo (E.M.I.) TW0259.

Interest: Children's classics.
Performance: Fairly standard.
Quality: Good standard.
Stereo: A considerable help.

Although both these pieces were originally written with children in mind, they have both featured regularly in concert programs attended mainly by adults. In the case of the Britten piece, it is customary when presenting adult performances to let the music speak for itself, and to leave out the narrative. There is no doubt in my mind that this performance is intended mainly for children, as on both sides the various instruments are carefully identified. This is very useful for the young folk, but I do feel that having introduced the instruments in the "Young Person's Guide" it is desirable to present the whole work right through without narration. This does not happen here, and the performance is, therefore, disjointed, through the stop-start system imposed by the narration. Apart from this, the record is entirely satisfactory. The performance is excellent, the narration is straightforward (although slightly tutorish in style) and the studio 2 sound is all one could wish for. (H.A.T.)

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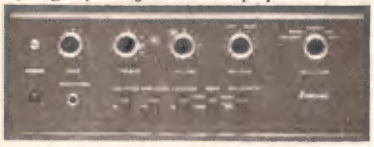

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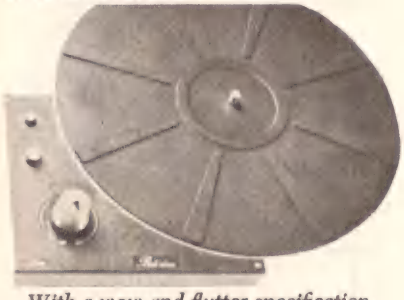

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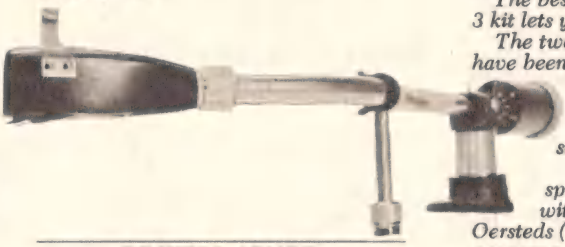

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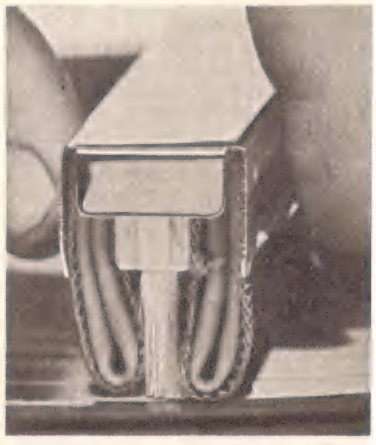

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that it is all a rather sad affair, to judge by the pensive mood of the songs included here. The 12 tracks include her famous "Autumn Rendezvous" hit, and the last track on side two, "The House Where I Grew Up" has a beautiful flowing melody, which I rate as one of Mlle Hardy's best efforts since "All the Boys and All the Girls." I don't know whether the remaining tracks are at all well known, but here they are in their English titles: I'd Change My Mind — If That Is — I'll Be There For You — Perhaps I Love You — There are Things — As — My Days are Going — How Happy They Are — Please Do Not Turn Round — You Are a Little Bit Mine.

Background support is minimal, so that the orchestra and chorus are barely noticeable at times, but I am sure that this was intentional, and fits the general mood of the disc. Most prominent is an instrument which sounds like a harpsichord, but it may be a lute. Whatever it is, it adds a pleasing touch to the arrangements. Apart from the first track, which sounded slightly fuzzy in the review copy, sound quality is adequate. (H.A.T.)

★ ★ ★

MAX MORATH: At The Turn Of The Century. Arranged and conducted by Fred Karlin. Stereo, RCA Victor LSO-1159.

Interest: A look back.
Performance: Outstanding.
Quality: Very good.
Stereo: Normal.

This is billed as an original cast recording but to most people who get hold of this record, it will rather be a series of highly diverting tracks, every one expertly performed by the one outstanding entertainer. There's a touch of the old music-hall melodrama, with all the sentiment and mannerisms of the day. Remember "Don't Go Into The Lion's Cage Tonight"?

There are monologues and a couple of comic songs: "Come After Breakfast" and "The Pump Song." There's some very well played piano ragtime including a keyboard explanation of Jelly Roll Morton's Tiger Rag.

And backing it all is a 20s-style orchestra that probably sounds a whole lot better than many orchestras of the day. In fact, this is one of the striking features of the album — a performance that belongs so convincingly to the front end of the century, yet reproduced in full-bodied stereo of the 70s with not a sign of a crackle nor a wisp of distortion.

A performance as good as this, as bright and as entertaining should not be passed over. Recommended (W.N.W.)

Popular Jazz

STUFF AND STEFF. Stuff Smith and Stephane Grappelly. Barclay Records (Festival) Stereo SBCL 933525 (Also in mono).

Interest: Jazz violin.
Performance: Worth hearing.
Quality: Well recorded.
Stereo: Clear separation.

The violin is not an instrument which adapts particularly well to the jazz idiom. Over the years, indeed, only a handful of musicians have managed to produce meaningful jazz solos on the instrument. They include Joe Venuti, Ray Nance, Eddie South and of course, the late Stuff Smith — but not, in my view, Stephane Grappelly.

The pairing of Smith and Grappelly on this LP, however, proved to be rather more successful than I expected. Stuff Smith, a much under-recorded player over the last 20 years of his life, plays well — if not quite at his peak. Although Grappelly's style is basically much too flowery and romantic, Smith's hard swinging playing obviously proved to be an inspiration for him.

Smith takes his inimitable vocals on his own compositions, "Blues In The Dunjeon" and "Skip It," and also on the standard "S'posin' "; Grappelly is featured (without Smith) on the beautiful ballad "Willow Weep For Me"; and both violinists play on the instrumentals "How High The Moon" and "This Can't Be Love."

The rhythm section of Rene Urtreger (piano), Michel Caudry (Bass) and Michel Delaporte (drums) is generally competent, if at times a little lumpy and stiff, particularly on the slow "Skip It."

The playing-time of the album is satisfactory at 38 minutes but the sleeve-note is just short of the absurd. It claims, for example, that Stuff Smith died "about 15 years ago." To put the record straight, Smith died of a heart attack in Germany in October, 1967, and, although no recording date is given, I am fairly sure that this LP was recorded not long before his death.

Stuff Smith enthusiasts will certainly wish to obtain the LP, although he has made superior recordings. Finally, Festival are to be congratulated on issuing this French Barclay album and one hopes that sales justify further releases of this kind. (T.F.C.)

★ ★ ★

SPACE. The Modern Jazz Quartet. Apple Records (EMI) Stereo SAPCOR 10.

Interest: Chamber jazz.
Performance: Beautiful.
Quality: Reasonable.
Stereo: Well balanced.

Jazz enthusiasts tend to adopt the extremes of attitudes about the Modern Jazz Quartet. On one side, many collectors admire their undoubted craftsmanship, the superb compositional talents of Milt Jackson and particularly John Lewis, and the delicacy, beauty and structured logic of the ensembles and solos. On the opposite side the Modern Jazz Quartet is regarded in some circles as unswinging, effete, lacking in muscle and a shameful waste of Jackson's solo abilities.

As a long-time admirer of the Modern Jazz Quartet, I regard the release of each new album as an event of considerable importance and this LP is no exception.

It contains two new John Lewis compositions, "Visitor from Venus" and "Visitor from Mars," symbolising respectively Love and War. These impressionistic sketches are rather more contemporary and less formal in their structure than has been evident in the last few Modern Jazz Quartet albums. But the stamp of John Lewis is still very evident in the careful, controlled development of the themes. As with most new Modern Jazz Quartet

(Continued on page 189)

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Car radio push button tuner .. **$4.50**
Pack and post 30c, Interstate 60c.

DIAL DRUMS, 5 inch, 3½, 3¾, **50c ea.**

ELECTROS 20 MFD 200 P.V. .. **20c**

TV POWER TRANSFORMER, $8.
300 mil. Two 6.3 windings, 200 volt secondary for Bridge Type Rectifier.

50 M CHOKE $1.
Pack and Post 30 cents, Interstate 60 cents.
300M Choke $2.50.

SPEAKER CABINET, 9½ x 9½ x 5½, **$4.**
Suit 8in Speaker.

M.S.P. MODEL 2MBC TWEETER SPEAKER. RANGE 5KHZ TO 20KHZ. NEW RELEASE, $4.50.

BATTERY SAVER, 6 or 9 volt DC 100MA **$8.50;** 300MA, **$10.00.**

SPEAKER ENCLOSURE, complete with 8in M.S.P. dual-cone speaker, 8 or 15 ohm **$15.80**
Cabinet without speaker **$10**
Cabinet size 16 x 10 x 8.

TRANSISTOR EXTENSION CABINETS
Complete with 5-inch speaker and lead. **$3.50.**

TRANSISTORS
2N1110 .. .. **40c**

INDOOR TV AERIALS 75c.
Pack and Post 25c.

STEREO AMPLIFIER 10 watts per channel solid state AT6 Garrard record changer, oiled teak cabinet, complete unit **$125**
Same unit with Garrard 3000 changer, **$115.**

TAPE RECORDER COUNTERS $1.75

POTS

1 meg. Dual Ganged Log	$1.25
1 meg. Dual Ganged Lin	$1.25
½ meg. Switch Pot double pole log	75c

6 VOLT PILOT LIGHT, screw in .. .. **ea. 10c**

RESIN CORE SOLDER 5 yards 75c

N.E.C. Cassette tape recorder cost $89. Sell new **$59.00**

Tab pots 500 ohm 1in .. .. .. **20c ea**

Electrolytic Capacitors
8MFD 450 WK 550 surge. **4 for $1.00**

CAR RADIOS, SOLID STATE, PUSH-BUTTON 8—6 VOLT. $45.

Ducon 2 pole dual concentric switch pots log 500K CT 100K 1 meg **75c**

STEREO SPEAKER LEAD, 10 cents yd.

DISCATRON CABINETS $2 EACH.

2N 1108, 2N 1110, 2N 1111. Transistors .. .. **50 cents each**

GARRARD PLUG IN STEREO CARTRIDGE, $6.00

TRADED-IN RECORD-CHANGERS. GOOD ORDER. $12 EACH.

SOLID STATE AMPLIFIER IN OILED TEAK CABINET, COMPLETE WITH MA70 B.S.R. RECORD-CHANGER, $85.

RADIOGRAM CABINET FOR STEREO, 3ft 5in x 14in x 15in. LEGS SUPPLIED. $15.

SPEAKER ENCLOSURES FOR 12in SPEAKERS, SOLID OILED TEAK. $27.50 each.

2 ONLY TRADED-IN STEREO AMPLIFIERS, $18 each.
3½ watts per channel.

Speaker Cabinets size 10 x 7 x 4¾. **$3.50**

Pots 50 ohm switch .. **50 cents each.**

American or Japanese 2 pin power plugs rubber complete with 2½ yards flex **50 cents.** Pack and post 10 cents.

MICROPHONES MAGNETIC OR CRYSTAL **$1.75**

SPEAKER CABINET, 16 x 10 x 8, complete with 6 inch M.S.P. dual cone Speaker tweeter, 3 inch and Crossover network **$18.75**

MAGNAVOX 8 WR, 10 WR 12 WR. Tweeter 3, 4 or 5 inch.

Speaker Plugs, 4 pin .. .. .. **15 cents**
Speaker Sockets .. .. **15 cents**

RADIOGRAM CHASSIS STEREO
Complete with valves 3½ watts per channel **$25**

POWER TRANSFORMERS

100 mil 6.3	$5.00
30 mil 6.3	$2.50

MSP 6 inch dual. cone — $.50 each.
MSP 3 inch tweeter — $3.75.

MULLARD BOOKSHELF SPEAKER CABINETS, $10 each.

STEREOGRAM CHASSIS, 5 watt per channel, complete except speakers, $35.

TRADE REVIEWS AND RELEASES

Grace tone arm and cartridge

International Dynamics (Agencies) Pty. Ltd. recently submitted for review a Grace F-8C magnetic cartridge equipped with an elliptical stylus. Also submitted was a Grace F-545 transcription-quality tone arm.

The Grace F-545 tone arm is a double-curved arm with a number of interesting features. The first is that the curving of the arm to arrange for minimum tracking error requires the counter weight for horizontal balancing to be placed on the opposite side of the arm to where it is usually found.

The lightweight headshell has the EIA standard locking collar as used on SME, Ortofon and Garrard equipment. The headshell should accommodate most cartridges with standard ½-inch mounting centres, the pattern of holes (in the headshell) providing for a wide range of overhang adjustment.

The arm has provision for balancing in the horizontal and vertical planes. The main counterweight is split in two sections — one finished in chrome and the other in matt black. There is a choice of chromed sections, one heavy and one light, to suit the cartridge in use. The tracking weight is set by a small sliding outrigger weight which is also used for balancing in the horizontal plane. Again, there is a choice of two outrigger weights, giving a range of stylus pressure from ¼ to 1½ grams or ½ to 3 grams.

The arm base has provision for height adjustment and for levelling, but the height adjustment is insufficient to allow the arm to be mounted on the base plate of turntables with shallow platters. If the turntable is one with a shallow platter, the arm would have to be mounted directly on the motorboard. This aspect is discussed later in the review.

A connecting cable is supplied which is fitted with R.C.A. style phono plugs and a 5-pin plug which connects to the socket in the base of the arm. Bearing friction is very low and the arm tracks well at stylus pressures in the region of half a gram. It would appear to be very good value for the price.

The Grace F-8C magnetic cartridge is of Japanese manufacture and, as we have come to expect with Japanese products, it is very attractively packaged. The transparent stylus assembly is easily removable and output terminals are colour-coded for easy connection. The manufacturer's specification is as follows:

Frequency response: 5HZ to 35KHz.
Channel Separation at 1KHz: -35dB
Load: 30K to 100K
Inductance: 360uH
Cartridge weight: 6.5 grams
Tracking weight: ¼ to 1½ grams
Effective tip mass: 0.55 milligrams

It will be noted that the specification includes a figure for the effective tip mass of the stylus assembly. This, together with the compliance and the effective mass of the tone arm, determines the tracking performance of the cartridge.

For our initial tests we mounted the cartridge in the Grace tone arm referred to above. The turntable we used has a light, shallow platter and has a cutout for a nine-inch (effective length) tone arm which would suit it to the Grace arm. Accordingly, the arm was mounted, with the base on the same level as the turntable baseplate. To enable the arm to track parallel to the record surface we had to mount the cartridge in the headshell using standoff pillars to increase the effective height of the cartridge. This meant that we had to use the heavier counterweights supplied with the arm to achieve balancing. Under the conditions, we found the resulting tracking performance of the cartridge to be good but not outstanding for a cartridge in its price range.

Subsequently, to allow the arm to be used with the lighter counterweights, we mounted it directly on the motorboard and were thus able to eliminate the standoffs from the headshell. With the "lighter" tone arm the tracking performance of the cartridge was improved. This would seemingly indicate that, if maximum performance is to be obtained with this cartridge, it must be used in a lightweight tone arm.

Under the new conditions, the cartridge tracked plus 16dB drum test band of the W. and G. 25/2434 test record at 1.5 grams and in this respect it is certainly the equal of any cartridge we have ever tested on this track. The following frequency response and allied tests were done at 1.5 grams.

Frequency response and separation between channels was checked using the CBS STR-100 test record and a Hewlett-Packard 331A distortion analyser as an AC millivoltmeter with a load of 47K. Frequency response was flat within plus or minus 1dB over the range from 20Hz to 20KHz, apart from a peak of plus 6dB centred on 15KHz, which is the cartridge resonance. Separation between channels ranged from a maximum of 30dB at 1KHz to a minimum of 18dB in the region of 15KHz.

Square wave response of the cartridge was excellent and the waveform on sine wave signals was good over most of the range. Sensitivity was 0.9mV/cm/sec. While the sensitivity is not particularly low, the cartridge did seem to pick up more than its share of hum with the amplifier at high gain settings. Buyers would have to be careful in their choice of turntable to use with this cartridge.

On music the cartridge gives an excellent performance, with the peak in the 15KHz region giving slight emphasis to the stringed instruments and cymbals. Transient response and clarity were very good. Most records could be tracked at less than one gram. We were able to play an entire Germani organ recital through at the ¼-gram setting with no hint of distortion.

To sum, the Grace F-8C is capable of very good tracking performance in a low mass tone arm and would be especially suited to those systems with speakers which are slightly lacking in the extreme treble register. The Grace F-545 tone arm is a high-quality unit capable of exceptional performance. However, its range of height adjustment could be increased to advantage to allow it to be more easily used with the low-mass, belt-driven turntables which are increasing in popularity.

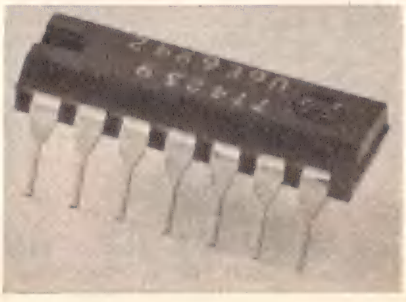
The retail price of the cartridge is $49.50 including tax, while the price of the arm is $39.50, including tax. Grace cartridges and the F-545 tone arm are available from retail outlets in most States. Trade enquiries should be made direct to the sole Australian distributors, International Dynamics (Agencies) Pty. Ltd., 4 Duke Street, Abbotsford, Victoria. (L.D.S.)

Zero voltage AC trigger for triacs

Triac power control circuitry using conventional triggering techniques can generate considerable RFI which is difficult to filter adequately. The RFI can be eliminated by triggering at the zero voltage points on the mains waveform.

Fairchild Australia Pty. Ltd., P.O. Box 151, Croydon, Vic. 3136, have recently introduced the uA742, a 14-lead integrated circuit intended for zero voltage triggering of triacs and thyristors. Besides enabling a considerable reduction in circuit complexity it offers the following features.

Direct operation from AC or DC 24 to 440 volts; input compatible with a wide range of sensor impedances; bridge sensing with adjustable hysteresis set points; provision for time proportioning operation; 50Hz and 400Hz operation with resistive or inductive loads; triggering in even numbers of consecutive half-cycles of the mains waveform.



ELNA CAPACITORS: SOANAR ELECTRONICS

Soanar Electronics Pty. Ltd. have announced the addition of interesting new lines to their range of Elna capacitors.

One item, of particular interest to designers of high-powered audio equipment, is an electrolytic capacitor with a rating of 4000uF at 75 volts working. It is attractively priced and small in size by previous standards, being 4 inches high and approximately 1¼ inches in diameter. It is suitable for use in many applications for which higher voltage units have been specified, provided the applied voltage does not exceed 75 volts. It would appear,

A selection of the new Elna capacitors. At the rear are two electrolytic capacitors, much smaller than previous ones of comparable rating. In front is a selection of T-caps in two voltage ranges.

for example, that the new capacitor would be quite suitable for use in the Playmaster 128 stereo amplifier.

Also introduced is a new line of disc ceramic capacitors designated as Elna "T-caps." Type TL provides capacitance values ranging from 220pF to .05uF with a 50V rating; it also includes a 0.1uF unit with a 25V rating.

Type TH provides a capacitance range from 100pF to .01uF, with a 500V rating.

Soanar advise that their stocks and lists are gradually being revised to substitute I.E.C. standard figures for "round" figures that have persisted, particularly for electrolytic capacitors. Customers can therefore expect to find "47" substituted for "50," and so on throughout the full range of values. Having in mind the wide tolerances that apply to bypass capacitors, substitution of near I.E.C. values in existing circuits will cause no problems.

Soanar also stress that Elna electrolytic capacitors may be used, without complication, in applications where the voltage actually applied is well below the full rated figure for a particular capacitor. They are therefore deleting from their range capacitors marked with very low working voltages (3V, 6V, 10V, 12V, etc.) and supplying capacitors marked with a working voltage as high as 50V. It has transpired that the higher rated capacitors are no larger than equivalent values carrying a lower rating and the latter have quite unnecessarily multiplied the stocks which dealers have had to carry. If an Elna capacitor will fit into the space allocated for it, it will operate efficiently at any voltage level which does not exceed the maximum rating.

Further information on these capacitors may be obtained from Soanar Electronics Pty. Ltd., 82 Carlton Crescent, Summer Hill, N.S.W. 2130, or in Melbourne.

NEW ALL TRANSISTOR STEREO AMPLIFIERS
ULTIMATE IN DESIGN—LONG DEPENDABILITY
USING ALL SILICON TRANSISTORS
36 WATTS—RMS

SPECIFICATIONS:
POWER OUTPUT: 18 watts per channel R.M.S. Total output 36 watts R.M.S.
FREQUENCY RESPONSE: From 20 cycles to 20,000 ± 1db.
HARMONIC DISTORTION: Less than 1 per cent at 14 watts output.
HUM AND NOISE: Aux. 70db. Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. and tuner 200 mv.
SPEAKER IMPEDANCE: 8 oms.
EQUALISED: Mag. RIAA.
TONE CONTROLS: Bass 50 c/s ± 12db. Treble 10 kc/s ± 12db.
LOUDNESS CONTROL: 50 c/s 10db.
SCRATCH FILTER: (High filter) at 10 kc/s 9db.
RUMBLE FILTER: (Low filter) at 50 c/s 5db.
PROVISION FOR TAPE RECORDER. Record or play-back with din plug connnection.
PROVISION FOR HEADPHONES with headphone/ speaker switch on front panel.

MODEL C300/20

$119.00 FREIGHT EXTRA.

DIMENSIONS: 16½in v 5½in x 11in deep.

Mounted in oiled walnut or teak veneered cabinet, with metal trim and matching knobs.

THE CIRCUIT INCORPORATES regular power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

MODEL C300/20/T

ABOVE AMPLIFIER WITH INBUILT A.M. TUNER

$144.00 FREIGHT EXTRA

12 WATT RMS PER CHANNEL VERSION OF AB OVE AMPLIFIERS AS PREVIOUSLY ADVERTISED ALSO AVAILABLE. $134.00 WITH TUNER.

NEW 24 WATT R.M.S. TRANSISTOR AMPLIFIER WITH INBUILT A.M. TUNER

MODEL C250

$118.00 FREIGHT EXTRA

DIMENSIONS 15½in x 4½in x 11in deep.
Cover finished in teak or walnut wood grain.
Incorporates 24 low noise silicon transistors plus 5 diodes.

SPECIFICATIONS:
POWER OUTPUT. 12 watts per channel 24 watts R.M.S. total (48 watts music power).
FREQUENCY RESPONSE. 20 Cycles to 20,000 ± 1db.
HARMONIC DISTORTION. Less than 1% at 10 watts.
HUM AND NOISE. Aux. 70db. Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. 200mv.
SPEAKER IMPEDANCE. 8 ohms.
EQUALIZED. Mag. RIAA.
TONE CONTROLS. Bass 50c/s ± 12db. treble 10kc. ± 12db.
LOUDNESS CONTROL. 50c/s 10db.
SCRATCH FILTER. (High filter) at 10kc. 9db.
PROVISION FOR TAPE RECORDER. Record or play back with standard din plug connection.
TUNER. This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial

$118.00 FREIGHT EXTRA.

MODEL C200V. BASED ON THE PLAYMASTER 118 WITH TUNER

Dimension 16½in x 5½in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

This amplifier is based on the Playmaster 118 circuit as featured in "Electronics Australia," to which has been added the following features:

- Inbuilt high gain A.M. tuner with a coverage of 530 to 1,600 K.C.
- Loudness control giving bass boost at low volume.
- Provision for tape, record and play-back, with din connector.
- Calibrated dial available for all States.
- EM84 tuning indicator giving accurate tuning with ease.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 gain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

APELCO DEPTH SOUNDER FROM AURIEMA

The Apelco MR-201B is a combination depth-sounding instrument. It provides a direct depth indication with a flashing neon light on a circular scale and also shows a profile of the sea-bed on its chart recorder. It is completely transistorised and current drain from a 12V supply is a mere 90mA. It was submitted for review by Auriema (Aust.) Pty. Ltd.

The Apelco unit operates in the conventional manner. An internal circuit generates a sequence of supersonic pulses which are communicated to the water by a transducer protruding from the bottom of the boat. After transmitting each pulse, the transducer is ready to respond to the same pulse when it is reflected back from the riverbed or seabed. Since the rate of transmission through water is substantially a constant, the time interval between the transmission and reception of each pulse is a measure of the depth of water underneath the keel. The returning pulse is amplified so that it will flash a light and also operate a recording pen, allowing the depth to be read off at a glance or recorded on a moving graph for future reference.

Housed in a rugged, 12-gauge steel case measuring 10½ x 6½ x 5¼in, which is finished in baked enamel, the MR-201B is clearly designed for long life. The circuitry is largely conventional, using silicon transistors but with unusual features such as automatic range changing for the chart recorder and the elimination of slip-ring contacts to couple the signal to the neon indicator and stylii.

The heart of the unit is a rotating wheel carrying the neon indicator, which flashes at the appropriate point on the circular "depth" scale. The wheel also carries the magnet which generates the oscillator control voltage when it flies past a keying coil. Finally, it carries three stylii which write on the paper chart by discharging a high voltage through the paper, the resulting char mark can be more precisely controlled than an ink pen and there is no problem with clogging.

The transmit circuit is basically a MOPA (master oscillator/power amplifier) operating at a frequency of 197KHz. The oscillator is normally in the cut-off condition but is triggered into oscillation by pulses from the keying coil. The resulting transmission pulse is approximately 0.5 milliseconds long and the pulse rate or sounding rate is 300 per minute. The transmission signal across the transducer is about 200 volts peak-to-peak.

For the receiver function, the output of the first two stages is detected and applied to the base of a controlled oscillator, which operates at about 33KHz. When no transmission or echo pulses are applied, the oscillator is cut off but, with more than about ¾ volt input, the circuit oscillates for the duration of the pulse. An increase in the amplitude of the input pulse will cause a corresponding, though not linear, increase in the amplitude of oscillation, thus giving a measure of the echo strength.

The output of the 33KHz oscillator is a transformer coupled to a class C amplifier tuned to 33KHz, the collector-tuned circuit being the primary of the transformer which triggers the rotary neon and supplies the voltage for the three stylii. Since the secondary coil rotates inside the primary there is no need for slip-ring contacts, thus eliminating a potential source of unreliability in this type of instrument.

The chart has three ranges: 0-80 feet, 0-160 feet and 0-240 feet while the neon indicator has a circular scale of 0-240 feet. When the pen for the 0-80 range is off-scale, the second pen takes over and the appropriate reading on the chart is correlated with that indicated by the flashing neon on the circular scale. The same sequence applies for the third pen. Thus, the

operator does not have to continually switch ranges to compensate for varying depth, though it would be necessary for the operator to note the scale in use on the chart if it was to be used for reference at a later date.

The chart operates at a speed of 24in per hour and the chart roll length is 50 feet. The chart recorder function may be switched off when not required, thus conserving paper.

The transducer is of barium titanate and is housed in a phosphor-bronze casting with an "epoxy" window. Three different transducers are available, to cater for different mounting requirements.

All circuitry, apart from the neon and styli driver transformer, is mounted on a fibre-glass printed board. Overall semiconductor complement is six transistors, one germanium detector diode and one zener diode.

Unfortunately, while the distributors were willing to arrange a sea trial, time did not permit us to make this evaluation. The unit appears to be well designed and manufactured with care. The instruction manual is comprehensive and contains information and diagrams illustrating the various transducer mounting arrangements.

Literature supplied by the distributors indicated that they are able to offer a whole range of depth sounders, a variety of transducers to suit different craft, a variety of accessories and chart paper. The literature mentions other equipment such as radio direction finders, loud hailers, marine speedometers, and automatic pilots, all made by Apelco.

Inquiries regarding price and availability of the unit featured and other Apelco equipment should be directed to the Australian distributors, Auriema (Aust.) Pty. Ltd., 433 Kent Street, Sydney, N.S.W. (L.D.S.).

NEW INSTRUMENTS FROM TEKTRONIX

Tektronix Australia Pty. Ltd. announces the Type 2901 Time Mark Generator, designed for calibrating and verifying the accuracy of oscilloscope time-base generators.

The Type 2901 is fully solid state utilising digital integrated circuits extensively. Outputs are derived from a temperature-stabilised 10MHz crystal oscillator which has an accuracy of ± 20 ppm from 0°C

An unusual instrument — one intended as a calibration source for other instruments. It is the Tektronix type 2901 Time Mark Generator.

to 50°C. Markers with 16 intervals of 0.1uS to 5S are provided. Sinewave signals of 2nS, 5nS, 10nS and 50nS are also available at the marker output connector.

It is expected that this instrument will be used for laboratory or production-line applications.

Tektronix also announces the Type 2101 Pulse Generator designed as a compact, 25MHz, 10-volt, general-purpose generator with separately variable period, duration, delay, amplitude and baseline offset.

Four operating modes provide undelayed pulses, delayed pulses, paired pulses, and a DC output. The risetime and falltime is 5nS. The period is variable from 40nS to 400mS. Pulse duration can be varied from 20nS to 400mS, or to 4S with an external trigger; maximum duty factor is 80 per cent. The pulse period and duration switches are mechanically coupled so that the period cannot be less than the duration for calibrated modes.

Positive and negative-going pulse outputs are available simultaneously, their amplitude is variable from 0.5V or less to 10V into 50 ohms. Independent baseline offset controls for each output permit

The Tektronix type 2101 Pulse Generator.

varying from the baseline + or —2V. Internal termination switches (one for positive-going and another for negative-going pulse outputs) select internal 50-ohm source resistance (IN), or current source function (OUT). Outputs are fully protected for accidental inputs.

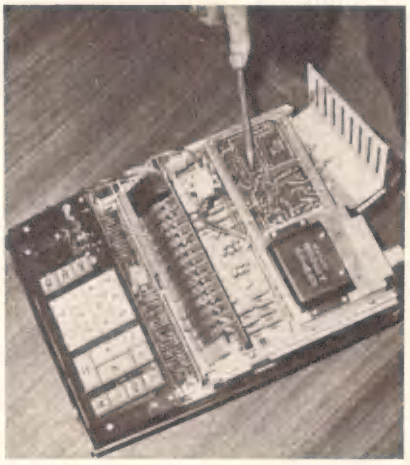
Triggering is selectable, internally or externally. A manual push-button provides a means to produce a single undelayed pulse, delayed pulse, or pulse pair. An external gate input permits output pulses for the duration of the gate.

The Type 2101 Pulse Generator will operate within specifications over an ambient temperature range of 0° to +50°C. (Tektronix Aust. Pty. Ltd., 80 Waterloo Rd, North Ryde. 2113.)

ELECTRONIC CALCULATOR

NCR has announced the release of an addition to its electronic calculator line. Designated as the NCR model 18-1, this attractively designed, lightweight unit features a 14-digit display and instantaneous answers to calculations.

A new feature is the half-size display of non-significant zeros to facilitate accurate reading of the displayed results. The NCR 18-1 provides working registers and one memory, and operates silently



Integrated circuits on a removable board facilitate maintenance of the NCR 18-1 calculator.

at electronic speeds and with computer accuracy.

Solid state construction and advanced circuitry design assure reliability and compactness of size. The unit measures 10½in x 14in x 4½in and weighs only 8.8lb.

Model NCR 18-3, previously announced, is a larger unit with 16-digit displays and two memories. It also includes an automatic square root feature that operates in a fraction of a second.

Both calculators offer fully automatic addition, subtraction, multiplication, and division with automatic round-off under switch control. (National Cash Register Co. Pty. Ltd., 14 York St., Sydney, 2000.)

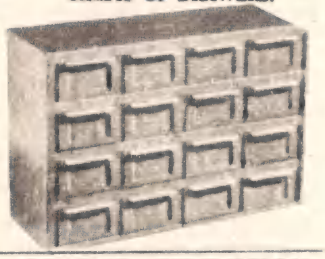
CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in, containing 16 drawers, each measuring 6⅛ x 3¾in x 2⅛in.

- TYPE C.D.1. With 16 undivided drawers.
- TYPE C.D.2. With 16 triple compartment drawers.
- TYPE C.D.3. With 8 triple compartment drawers, and 8 undivided drawers.
- TYPE C.D.4. A 17⅛in x 11⅞in Galvanised Chest containing 4 full-length dawers each measuring 15¾in x 6⅝in x 2⅛in.

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.

WRITE FOR FREE CATALOGUE AND PRICE LIST OF TOOL BOXES AND CHESTS OF DRAWERS.



COLOUR TELEVISION

With particular reference to the PAL system by

G. N. PATCHETT

This book now available

$5.95

"PIPGRAS" HOLE PUNCHES

"PIPGRAS" Hole Punches are made from Alloy Tool Steel, and cut clean and accurate holes in sheet metal. They make a smooth, perfect hole without reaming or filing.

SCREW TYPE, ROUND

Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

Type No.	Nominal Size	Actual Size	Water Pipe Size	Pilot Size (I.D.)	Drill Size	Price Each
32.S	⅛in	0.507in	—		¼in	$2.17
40.S	5/32in	0.618in	¼in	5/16in		$2.17
48.S	¾in	0.742in	⅜in	5/16in		$2.80
56.S	⅞in	0.884in	½in		⅝in	$3.80
64.S	1in	1.008in	—		⅝in	$4.10
72.S	1⅛in	1.133in	¾in		⅝in	$4.83
76.S	1 3/16in	1.172in	—		⅝in	$4.83
80.S	1¼in	1.258in	—		⅝in	$4.97
88.S	1⅜in	1.382in	1in	7/16in		$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

96.S	1½in	1.512in	—	9/16in	$6.48
112.S	1¾in	1.762in	1¼in	9/16in	$7.48
128.S	2in	2.014in	1½in	9/16in	$8.35

BELLPHONE

Pick up the receiver and dial push number desired.

Large $13.50 per pair
Small $10.12 per pair

KALTRO SVC TV-RADIO REMOTE CONTROL LISTENER

This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote Control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

Price $8.75

Trade enquiries prices available on application

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Free parking at Rhodes

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Phone:
73-0211 Rhodes
29-4451 City
73-5586 Sat. Morning.

THIS MONTH'S SPECIALS

Radar 1XR Power Supply	$30.60
Radax 05XR Power Supply	$20.40
Lapel Microphone X67 ..	$00.90
Table Microphone BM3 ..	$ 7.50

8 WATT STEREO AMPLIFIER MODEL SA-80S

SPECIFICATIONS

Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S

Speaker: 4in. 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5⅞ (D).
Finish: Walnut lacquer.

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All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

SPECIFICATIONS:

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ●Hum: 0. ● Battery: 9 volts.

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TRADE RELEASES—in brief

PLESSEY DUCON PTY. LTD., P.O. Box 2, Villawood, N.S.W., 2136. **Integrated circuits, SL 600 series.** For professional communications, they meet the full military temperature specification. SL610 wideband RF voltage amplifier, intended for the 2-76MHz communication band, has high signal handling capability of 250mV RMS. SL612 IF amplifier has a voltage gain of 50 and a bandwidth from 0.1MHz to 15MHz. SL621 SSB AGC generator will follow fading signals but hold a fixed AGC level during pauses in speech; it also recovers rapidly from impulse noise interference. SL620 voice operated gain adjusting device is an AGC generator designed to control the gain of the SL630 when this is used as a microphone amplifier; it will hold the amplifier output level between 70mV and 87mV RMS for a 35dB range of audio input. SL630 audio amplifier has a gain of 40dB, will operate from any supply in the range 6 to 12V, and features a wide range logarithmic AGC facility. SL640 double balanced modulator replaces the diode ring at frequencies up to 76MHz; it needs no transformers, saves power and requires no external balance adjustment.

TECHNICO ELECTRONICS, a division of Pye Industries Ltd., P.O. Box 12, Marrickville, N.S.W. 2204. Agents for Princeton Applied Research Corp., U.S.A. **Pulse quantiser and rate meter, model 231.** The instrument's input pulse amplifier is on a separate printed circuit board for location in or near the same enclosure as the photomultiplier tube. This minimises parasitic capacitance and the effects of electrical noise on input signals. The instrument quantises pulses whose amplitude exceeds a threshold level which can be set between 50mV and 5V. Three outputs are provided to interface with chart recorders, digital counters and integrating DVMs. In addition, a quantised pulse output is available for input to lock-in amplifiers.

AURIEMA (A'SIA) PTY. LTD., 443 Kent Street, Sydney, 2000. Agents for Sarkes Tarzian Inc., U.S.A. **Silicon rectifiers, 2AF series.** Inexpensive plastic encased silicon rectifiers for applications where high operating temperatures are not encountered. Features: DC current rating 2A resistive or inductive load, at 25 degrees C; available in six peak inverse voltage ratings from 100V to 1KV DC; maximum RMS input voltages range from 70 to 700V; designed to sustain peak one-cycle surge currents up to 60A; insulated case measures 0.25in long by 0.2in diameter.

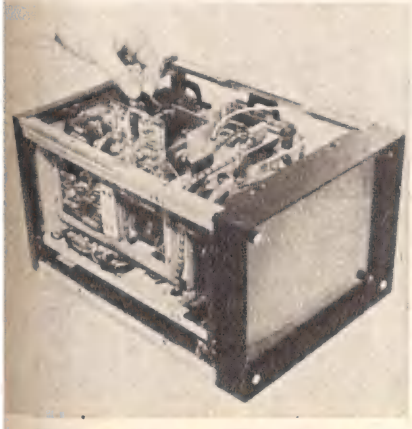
RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113. **Digital master clock, type SA 7105.** A highly stable master clock which incorporates ICs and provides visual time indication in hours, minutes and seconds. Either 12 or 24-hour time may be internally selected. Parallel BCD outputs are provided for operation of remote slave clocks, data acqusition systems, digital printers, etc. The SA 7105 may be operated from external or internal frequency standards. Features: internal standards stability to 2 parts in 10^9 per day; capability 100 slave clocks; large cold-cathode numerical indicators; standby power supply for no-break operation.

R. H. WAGNER & SONS PTY. LTD., 524 Flinders Street, Melbourne, 3000. Distributors for Rodenstock, West Germany. **Apo-Ronar distortion-free lenses for IC production.** Lenses in normal mount can now be specially corrected for any requested reproduction ratio as well as the standard 1:1 ratio. Such a special correction has to be made individually for each lens which results in a delivery time of approximately three months. To avoid confusion with normal Apo-Ronar lenses, the specially corrected one will be engraved with the respective ratio.

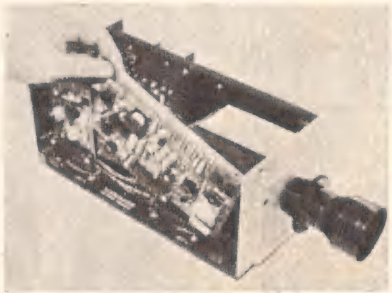
NUCLEONICS ELECTRONICS AND TELECOMMUNICATIONS (N.E.T.) PTY. LTD., 6-8 Clarke Street, Crows Nest, N.S.W. 2065. **Digital level meter, type TR-3141.** The instrument has a frequency range from 20Hz to 200KHz and a 3-digit display. Features: automatic level measurement; 80dB dynamic range; level measuring range on 600 ohms is plus 20 to minus 59.9dBm. Applications include measurement of frequency characteristics of amplifiers and filters, level measurement of transmission lines, gain of amplifiers, determination of signal to noise ratio.

ROYSTON ELECTRONICS PTY. LTD., 22 Firth Street, Doncaster, Vic. 3108. Agents for Hughes Aircraft Co., U.S.A. **Shift registers and MOSFET switches.** HDSR 2164, dual 64-bit two-phase dynamic shift register, first of a series of ion-implanted high-speed MOS devices. Can handle data at rates to 10MHz, has low threshold voltage characteristic and silicon nitride insulator processes to allow compatibility with TTL and DTL. HSSR 2064, dual 64-bit static shift

WARBURTON FRANKI INDUSTRIES PTY. LTD., P.O. Box 35, South Melbourne, Vic. 3205. Agents for K.G.M. Vidiaids Ltd., England. **High resolution CCTV equipment.** Suitable for data transmission, industrial inspection, process control, surveillance, etc. Includes cameras, monitors, switching and distribution equipment for high-quality picture transmission from microfilm, microfiche, typewritten or hand-written copy, and other forms of information. The system is of understressed, solid-state, modular design and all circuit boards and individual components are of plug-in design. The resolution is better than 800 lines horizontal and 400 lines vertical.



A K.G.M. monitor. Controls may be internal and pre-set except for front panel on/off, picture polarity and brightness.



A CCTV camera from K.G.M.

register. Capable of serially storing data to 1MHz and can handle two 64-bit words or two 16-digit BCD words. HSSR 2016 dual 16-bit static shift register, is also available. HDGP 1000 MOSPET switch is a 300 ohm diode-protected circuit for long time delay and low frequency circuits. HDGP 1001, MOSFET switch, has switch resistance less than 30 ohms and may be used to interface DTL or TTL circuitry to MOS levels or for driving TTL circuitry from MOS arrays.

E.M.I. (AUSTRALIA) LTD., Commercial & Advanced Electronics Division, 14-18 Parramatta Road, Homebush, N.S.W. 2140. **Slow scan 12in oscilloscope, type L.P. 37.** Designed for medical and educational applications where large screen, long persistence waveform monitoring displays are advantageous. It uses the suppressed raster technique which allows as many display traces as may be required without loss of bandwidth or trace brightness. Features include: four traces; frequency response DC to 1KHz limited only by sample rate of 17,000 per second; P7 phosphor; sync level adjustable with either positive or negative selection; sensitivity 20mV per cm maximum; time base 1mS/cm to 1S/cm with selection of free-running, triggered or one-shot operation.

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3147. **Gallium arsenide phosphide lamp, type HP 5082-4403.** A solid-state red light-emitting diode designed to displace miniature incandescent and neon lamps in indicator applications. Features include: can tolerate shock, vibration, and repeated switching with a typical useful life of 1,000,000 hours; low power, 1.8V at 20mA; high visibility over a broad angle; free from turn-on transients and compatible with most ICs without the cost of drive components; can be front panel mounted with a simple snap-in clip or mounted directly into a circuit. Price 50c in large quantities.

Two light emitting diodes mounted on a printed circuit board.

VARIAN PTY. LTD., 38 Oxley Street, Crow's Nest, N.S.W. 2065. **Limiters, ITLM series.** Designed to provide both amplitude limiting and nearly constant phase angle throughout their dynamic range. Typically, total phase shift is less than 7.5 degrees over a 70dB range. Available for either 50 or 60MHz, the limiters can handle either pulse or CW signals.

DIGITAL EQUIPMENT AUSTRALIA PTY. LTD., 75 Alexander Street, Crow's Nest, N.S.W. 2065. **Signal averaging system, type Lab-8.** Based on Digital's least expensive computer, the PDP-8/L, or on the PDP-8/I, the system converts analog signals to digital form, then averages and displays them. There are two forms of the averaging program, basic and advanced. The basic program remains in core and can sample the signal at any rate between 2,000 and 30,000 times a second. The advanced program can sample from once every two seconds to 5,000 times a second, and allows several other possibilities including parameter specification, simultaneous reading, pre-synchronisation averaging, confidence limits, and trends.

INFORMATION ELECTRONICS LTD., 42 Mort Street, Braddon, A.C.T. 2601, has announced the following appointments. Mr Ian Nicholls as research and development manager. He was formerly assistant director of the computing centre at the University of Western Australia. Mr Wilson MacMillan as manufacturing manager. He was formerly test engineering manager for IBM in England. Mr William Taylor as marketing manager. He was formerly marketing representative for Control Data Australia Pty. Ltd. in Canberra. Mr S. A. Westwood as administration manager. He has been with the company since its inception early in 1969, and was formerly Canberra manager for Standard Telephones and Cables Pty. Ltd.

RUTHERFORD ELECTRONICS PTY. LTD., P.O. Box 30, North Balwyn, Vic. 3104. Agents for National Semiconductor Corp., U.S.A. **Hex inverter, type DM7005/8005 (SN5405/7405).** An open collector version of the company's standard hex inverter monolithic IC. It has six inverting gates with standard TTI inputs, but the outputs are open collector transistors. These can be wired together, or taken to higher voltages with a suitable resistor. The circuit is guaranteed to with-

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(Above) Advance OS25 Oscilloscope has vertical amplifier bandwidth from DC to 5 MHz with a max. sensitivity of 100 mV/cm on each channel. Time base gives sweep speeds from 1 sec/cm to 0.5 μS/cm using switched and fine controls. Bright clear display on 5" helical PDA tube.

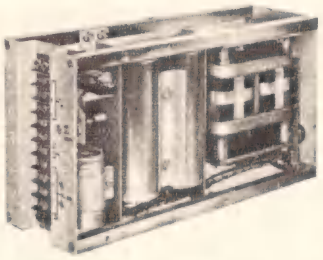
☐ Tick for further details.

(Above) Advance TC9 Timer Counter is a 6-digit instrument capable of measuring frequencies up to 32 MHz with 0.1 Hz resolution. Freq. Measurement: 2 Hz to 32 MHz. Time Measurement: 1 μS to 10 S in decade steps. Sensitivity: 3 position attenuator providing 10 mV, 100 mV, and 1 V RMS.

☐ Tick for further details.

(Above) Advance TC11 & TC12 Timer Counters are designed to measure frequencies up to 15 MHz. TC11 has 4-digit display with 1 Hz resolution. TC12 has 5-digit display with 0.1 Hz resolution. Freq. Measurement: 2 Hz to 15 MHz. Time Measurements: TC11 10 μS to 1 S, TC12 10 μS to 10 S. Sensitivity: 10 mV, 100 mV and 1 V RMS.

☐ Tick for further details.



(Above) Advance PM Series Stabilised Modular Power Supplies are designed in modular form to be used as integral parts of other equipment, either singly or in multiples. Voltage Range 0-50 volts. Current capability 500 mA to 10 A. Fully transistorised, with silicon semi-conductors which permit operation up to +60°C.

☐ Tick for further details.

JAYEM

(Above) Jayem S100 Tr Multitester provides AC and DC measurements, also resistance, capacity and level. Also measures the more important parameters of transistors, both NPN and PNP types. DC 100,000 o.p.v. A 3" anti-parallax scale and sensitive 7.5 μA meter. Shockproof suspension and full overload protection.

☐ Tick for further details.

(Above) Jayem JM-01 Micromegmet is designed for the rapid and accurate testing of insulation resistance such as motors, generators, power-lines, etc., and for voltage detection and continuity checks. Rated voltage is 500 V and measuring range is 0.01-100 Megohms. Fully transistorised with 1 transistor and 4 diodes. Only 6" x 3⅛" x 1⅝", in soft leather carrying case with 1 pr. of test leads.

☐ Tick for further details.

KOVO

(Right) Kovo Megmet is a portable insulation tester for measuring insulation resistance of DC and AC mains, machines and appliances. The generator is driven by 2 sets of gears, the tooth wheels being of bronze and the pinions of steel. **Models Available:** Megmet 500 500 V, Resistance: 50 Kohms to 50 Megs; Megmet 1000 1000 V, Resistance: 100 Kohms to 100 Megs.

☐ Tick for further details.

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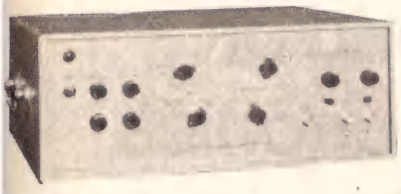
AMALAGAMATED WIRELESS (A'SIA) LTD., Engineering Products Division, P.O. Box 96, North Ryde, N.S.W. 2113. Agents for Marconi Instruments Ltd., U.K. **Grey scale generator, model TF 2909.** Designed for the checking of non-linear distortion on colour and monochrome TV transmission systems, the instrument has a differential gain accuracy of 0.1 per cent, a differential phase accuracy of 0.1 degree, and a wide range of waveforms and test facilities. If used with the sine-squared pulse and bar generator, TF 2905/8, will perform most tests required on TV transmission systems.



Main advantages include: Wide choice of output waveforms (sawtooth; 5, 7 or 10 riser staircase on every line or on every 4th or 5th line; or full-line bar on every line); Internal crystal controlled or external sub-carrier can be superimposed on sawtooth or staircase with a colour burst sync on every line; Average picture level changing (automatic or manual variation of bar amplitude between black and white level on successive lines); Line sync pulses can be switched on or off as required; Can be locked to external pulses to produce a composite video waveform; Good specification for residual distortion on output waveform; Positive or negative pedestal can be added to sawtooth or staircase waveform.

WARBURTON FRANKI INDUSTRIES PTY. LTD., Box 1523, G.P.O., Sydney, 2001. Distributors for Bird Electronic Corp., U.S.A. **High power RF attenuator model 8323.** Applications include high power measurements with low level meters and RFI analyses on high power transmitters. Features include: 30dB attenuation over frequency range DC to 500MHz within 0.5dB which can be corrected to within 0.2dB at six calibration frequencies and at DC; can be used as RF coaxial load resistor with a maximum VSWR of 1.10; unidirectional and electrically equivalent to symmetrical T pad.

PLESSEY DUCON PTY. LTD., P.O. Box 2, Villawood, N.S.W. 2163, has been appointed representative for mechanical filters manufactured by Kokusai Electric Co. Ltd., Japan. The FK series covers 100HZ to 6KHz with a patented three-prong tuning fork and may be used as receiving filters or oscillating resonators operating with wide bandwidths and high selectivity. MF series covers 100Hz to 600KHz and is designed primarily for bandpass filters of IFs 100KHz, 250KHz, 455KHz, 500KHz and 575KHz. Included in this series is a special group for telephone terminal equipment of the V x 12 direct modulation system. The ML series, with frequencies from 300Hz to 30KHz, ranges from narrow band filters with less than 0.5pc bandwidth to wideband filters with bandwidths of 1pc to 10pc.

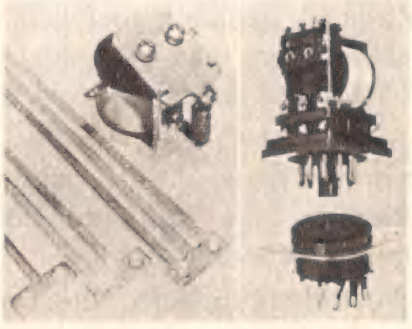
ASSOCIATED CONTROLS PTY. LTD., 14 Enterprise Avenue, Padstow, N.S.W. 2211, has announced that its Victorian offices have moved to Suite 20, 73 Mahoneys Road, Forest Hill, 3131. The telephone number is unaltered, 878 6555. The company also announced the appointment of Mr Keith Main as Australasian sales manager responsible for sales throughout Australia, New Zealand and Papua-New Guinea. Formerly Victorian sales manager, he has been succeeded in that position by Mr R. W. Davis.

FERRIS BROS. PTY. LTD., 752 Pittwater Road, Brookvale, N.S.W. 2100, has commenced the manufacture of TV antennae in Brisbane. Local production will enable the company to improve its service to Queensland electrical retailers and installers. Ferris has been manufacturing antennae under licence to Channel Master Corporation of the U.S.A. since 1956.

WATSON VICTOR LTD., 95-99 Epping Road, North Ryde, N.S.W., has opened a sales promotion and information office in Birmingham, England. Mr D. F. Ansell, associate director and medical division manager, supervised the opening. He was accompanied by Mr Clive Chaloner, a company specialist in the applications of medical electronic equipment, who has remained in England to take charge of the office. The company has also notified its new postal address, P.O. Box 100, North Ryde, N.S.W. 2113, and telex numbers, in Sydney 21602 and in Melbourne 31412.

H.M. COMPONENTS and CO., P.O. Box 14, Williamstown, Vic. 3016, has been awarded the exclusive agency for the products of Oswald Haussmann Gmbh. of Berlin. The range includes push buttons, electronic counters, button strips and keyboards.

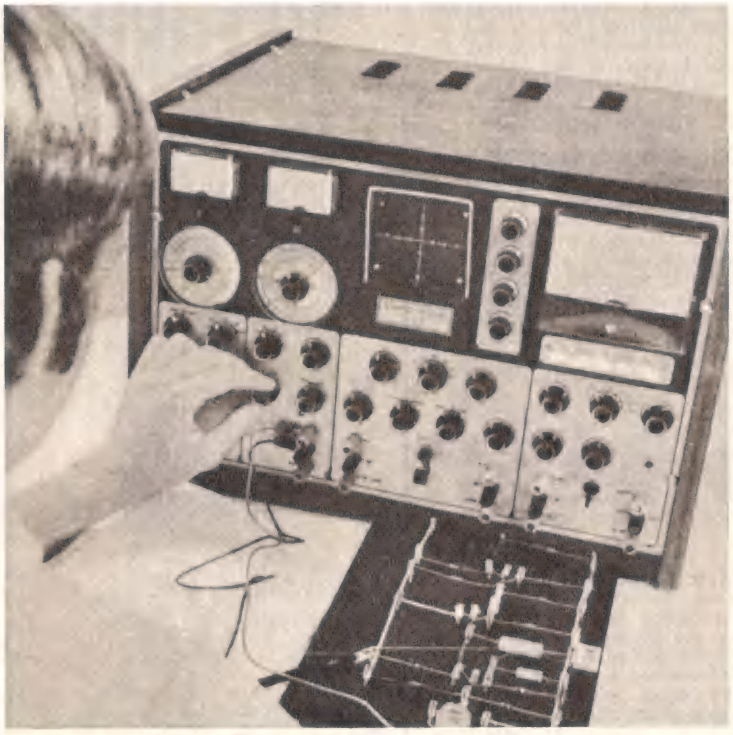
M.I. AUSTRALIA PTY. LTD., 196 Silverwater Road, Lidcombe, N.S.W. 2141, has been appointed sole Australian distributors for the complete product range of Keyswitch Relays Ltd. of the U.K. Keyswitch manufactures plug-in miniature and sub-miniature relays, solenoids, miniature lever keys, plug-in component boards, P.O. 3000 and 600 type relays. Mr Peter Holbrook has been appointed specialist sales engineer, relays, responsible for the full range of Keyswitch products. The company has also advised that its Adelaide branch has moved to new larger premises at 610 Port Road, Allenby Gardens, S.A. 5009. The telephone number is 46 1604.



Two Keyswitch relays. A KMK miniature solenoid (left) with three types of armature extensions available, and a KMKP miniature relay (right).

E.H.K. INSTRUMENTS, P.O. Box 7, Essendon North, Vic. 3041, provides a three-day service for one-off and small quantities of printed boards in either phenolic paper or epoxy glass. Boards are normally photographically reproduced from artwork supplied by customers, but the company will prepare artwork from sketches supplied. A price list and a free folder on how to prepare artwork are available on request.

S. E. WILLIS TRADING CO. has ceased operating from Melbourne, but will continue to operate from Perth. Until suitable premises are found, the business will be conducted only by mail order with the address Box X2217, G.P.O., Perth, 6001. The company is also proposing to set up facilities for the manufacture of printed circuits and will be prepared to handle small quantities including one-offs.



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TECHNICAL BOOKS AND PUBLICATIONS

Information theory

THEORY OF COMMUNICATION, by A. E. Karbowiak. Published by Oliver and Boyd Ltd., Edinburgh, 1969. Soft covers, 5½in x 8¼in, 186pp., many diagrams. Price in Australia $5.80.

This is the fifth volume to be released in the Oliver and Boyd "Electronic and Electrical Engineering Texts'" series, which is designed to provide undergraduate engineering students with up-to-date subject texts at a modest price. "Theory of Communication" has been written by Professor Karbowiak, of the School of Electrical Engineering at the University of New South Wales.

As the title suggests, the book is designed as a text for courses in information theory and communication systems. However, in contrast with many of the existing texts dealing with this subject, which adopt a somewhat dogmatic and abstract approach, the approach which has been adopted in this case is one which emphasises basic concepts and assumptions, and seeks to explain the reasons for choosing particular ways of defining and solving problems. Professor Karbowiak explains in his preface that this approach has been adopted deliberately, in an effort both to satisfy and to encourage the increasing desire of students to examine the "why" of engineering in addition to the "how."

The success of this approach is well illustrated by the fact that although the book was primarily written for final-year undergraduate students, and for students preparing for a Master's degree, and has been used thus with considerable success, it has been found that certain chapters have been used and found very helpful for teaching first-year students with no existing background in electrical engineering. It thus seems likely that the book may even be of interest to final-year high school students.

The content and order of treatment may be seen from the chapter headings: 1 — Introduction; 2 — Patterns and Waveforms; 3 — Modulation, Sampling and Coding; 4 — Signal Analysis and Transmission Through Networks; 5 — Noise and Stochastic Signals; 6 — Information Theory of Discrete Systems; 7 — Properties of Continuous Channels and Signals; 8 — Communication Systems and Information Theory; 9 — Systems and Information Theory; 10 — The Challenge. The book ends with four mathematical and data appendices. A bibliography and an index. In keeping with the author's intentions, each chapter begins with a discussion of basic concepts, and ends with a summary and list of conclusions. This together with the generally concise and smooth-flowing text should make the book of very great value to students, and also to engineers seeking an easily read "brush-up" text.

The review copy came from Rigby Limited, of South Australia, who are Australian distributors for the publisher. However, we understand that copies are already in stock at all major bookstores. (J.R.).

Quantum electronics

FUNDAMENTALS OF QUANTUM ELECTRONICS, by R. H. Pantell and H. E. Puthoff. Published by John Wiley and Sons. Inc., New York. 1969. Hard covers, 6¾in x 9¼in, 361pp., many diagrams. Price in Australia $16.75.

Not a book for the general technical reader, this one, but rather for the postgraduate student, applied physicist and semiconductor device designer. The authors are Professor and research associate, respectively, in the Electrical Engineering department of Stanford University in California, and have written the book as a text for a postgraduate course in Quantum Electronics.

The stated aim of the book is to provide a text which bridges the gap between the basic concepts and mathematics of quantum mechanics, and the analysis of the macroscopic behaviour of useful quantum electronic devices such as the injection laser. As part of this aim the authors adopt a problem-orientated approach, in which the "density operator" is used to determine the "expectation value" of the mathematical operator corresponding to each macroscopic observable variable. By reformulating the equations solely in terms of these expectation values, using equivalent expressions for the density operator, this procedure allows the derivation of a final set of simultaneous equations which deal directly with such observable macroscopic variables as polarisation and electric field.

There are eight chapters, the titles of which give an ideal of the content and its order of presentation: 1 — Quantum Theory; 2 — Dipole Transitions; 3 — Resonant Processes; 4 — Lasers; 5 — Nonlinear Effects in Quantized Media; 6 — Field Quantization; 7 — Interactions Between Radiation and Phonons; 8 — Electrons In Crystals. The book concludes with thirteen mathematical appendices, an index, a table of physical constants and a nomograph of electromagnetic conversions.

The text of the book seems both concise and lucid, and is amply illustrated with diagrams. A list of recommended references and a set of tuitional problems are given at the end of each chapter, so that the book should be well suited both as a course text and as a text for private study. The reliance placed upon specific devices in the development of the content material is quite small, so that the book should date relatively slowly.

The review copy came from the Sydney office of the publisher, and we understand that stocks are already held by local bookstores. (J.R.)

Electricity textbook

ELECTRICAL TECHNOLOGY: by Edward Hughes, D.Sc., Ph.D., 4th edition published by Longmans, Green and Co. Ltd., London. Line drawings and diagrams, 5¼in x 8¼in, 709 pages. Soft cover $4.10, hard cover edition $5.60.

A volume designed to cover the second and third year syllabus of the British O.N.C. in Electrical Engineering and the first year Electrical Engineering Degree course at tertiary level. As such it is definitely not a book for the beginner, presupposing as it does at least a working familiarity with mathematics commensurate with this level of study.

This is not to suggest, however, that it has no value apart from its intended function as a study text. Much of the material is presented in a form which makes it a useful reference work of basic electrical information.

The twenty-three chapters cover a wide range of electrical theory, beginning with circuits and introducing the reader to such necessities as Kirchhoff's

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Throughout each chapter the reader's grasp of the text is heightened by the use of a large number of worked examples together with a set of test questions at the conclusion of each chapter.

The latter chapters cover a comprehensive introduction to valve theory and, in somewhat less detail, semiconductor devices. Lighting and electric lamps, electrical measurements and an examination of primary and secondary cells complete the book.

As indicated, this book is basically for the electrical engineering student, providing at the same time a fair cover of fundamental reference material. Our copy came from the Australian distributors, Rigby Ltd., 30 North Terrace, Kent Town, South Australia. (A.D.N.)

Electronic materials

PRODUCING FILMS OF ELECTRONIC MATERIALS, by Marshall Sittig. Published by Noyes Data Corporation, Park Ridge, N.J., 1970. Soft covers, 8-3/8in x 10¾in, 295pp., many diagrams. Price in U.S.A. $35.

A further release in Noyes Data Corporation's series "Electronics Materials Review," which are specifically intended to supply information on recent developments in electronics processes and techniques for those in production, management, research, engineering development, marketing and education.

Like "Doping and Semiconductor Junction Formation," reviewed recently, and the other books in the series, the present volume is basically an in-depth review of the specific content of recent U.S. patents in the field concerned. As such it is intended to provide a concise, accurate and (especially) topical reference to the current state of the art, a reference whose content should be considerably in advance of that in currently published texts, journals and other reference literature.

The content material is grouped under the following general headings: 1— Introduction; 2 — Cathode Sputtering; 3— Vacuum Evaporation; 4— Gas Plating; 5— Electroplating; 6 — Electroless Plating; 7— Film Deposition From Reacting Vapours; 8 — Explosive Evaporation; 9 — Squeezing on Optical Flats; 10 — Electron Deposition; 11 — Ion Beam Deposition; 12 — Reaction and Deposition from Solution; 13 — Oxide Films by Reaction at Solid Surfaces; 14 — Carrier Transport in Vapour Phase; 15 — Future Trends.

In each section the processes and techniques concerned are discussed thoroughly and concisely, illustrated in most cases by coded patent-form diagrams. Full details are given of the individuals and companies associated with a process and its patent. The author in fact stresses in his foreword that great care has been taken to ensure that this information is not only reliable and comprehensive, but also sufficiently detailed to avoid any legal criticism for "insufficient disclosure."

An initial examination of the book tends to give the impression that it is somewhat overpriced. It is quite unpretentious in appearance, with plain card covers and unjustified text suggesting photocopying from an electrically typewritten manuscript. However the foreword explains that this format has been used deliberately in order to reduce production time to a minimum. In view of this and the wealth of concise practical information which it contains concerning current electronics material technology, it should despite appearances prove of very great value — not only to those in industry and research, but also to lecturers and students involved in engineering courses at both graduate and undergraduate level.

The review copy came directly from the publisher, whose address is Noyes Building, Mill Road at Grand Avenue, Park Ridge. New Jersey 07656, U.S.A. (J.R.)

★ ★ ★

THE RADIO AMATEUR'S HANDBOOK. Published by the American Radio Relay League Inc., Newington, Conn., U.S.A. Amply illustrated with line drawings and photographs. Soft covers, 643 pages, 9½in x 6½in. Australian price $6.50 plus postage.

This book was reviewed in our May, 1970 issue on page 153. We have been informed that copies are available from Technical Book and Magazine Co. Pty. Ltd., 289-299 Swanston Street, Melbourne, 3000.

Broadcasting in U.K.

BBC HANDBOOK 1970. Published by the British Broadcasting Corporation, London. Stiff paper covers, 303 pages, 4¾in x 7¼in, 33 pages of black and white illustrations and eight pages of colour, various maps and tables. U.K. price 10s.

In addition to the usual facts and figures, policy statements and financial reports, this year's BBC Handbook clarifies the background to the McKinsey report on the BBC's resources and to the plans for "Broadcasting in the Seventies," which have evoked much discussion in the U.K. In his foreword, Lord Hill of Luton, Chairman of the BBC, deals with the effect of the changes and touches on the BBC's problem of finance.

Mr Charles Curran, the BBC's Director-General, contributes a major article which surveys the Corporation now and discusses how it will develop in the next decade. The section on radio summarises the content of the four radio networks and explains how the former English Regions will be superseded by a widespread local radio system with coverage of about 90 per cent of the population.

The engineering section, with explanatory maps and tables, shows how television (with the continued expansion of the 625-line system) and VHF radio are constantly improving in range and quality. This section notes that certain programs are broadcast stereophonically from eight VHF sound transmitters and five relay stations. The number of programs will be increased when more equipment has been modified for stereo working.

Although the Handbook is of more interest in the U.K., it nevertheless allows comparisons to be made between the proposed developments in the U.K. and those planned for this country. Copies should be available through larger booksellers, or may be ordered from BBC Publications, 35 Marylebone High Street, London W.1. England. (J.H.)

BASIC ELECTRONICS

"Basic Electronics" is a quarto-size 128-page book published by "Electronics Australia." Based on a series of articles called the "Basic Radio Course," the present third edition was up-dated by rewording sections which were no longer appropriate.

The purpose of the book is to give a basic insight into electronics in general, and in particular to the aspects of it concerned with sound radio, television and sound reproduction. Those who work through this book will have a basic knowledge from which to progress to more advanced textbooks covering specific aspects of electronics.

Copies of "Basic Electronics" may be obtained by writing to "Electronics Australia," Box 2728, G.P.O., Sydney, 2001. Enclose postal order, money order or cheque for $2.20, which includes postage.

LITERATURE—in brief

TELECOMMUNICATION JOURNAL, Vol. 37, No. 3, March, 1970. Published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Contents include: "Introduction of intercontinental automatic telephone operation between the United Kingdom and the United States," from the American Telephone and Telegraph Co.; "Promotion of public and private telecommunications and frequency management in the developing countries," by V. V. Rao.

Under the heading of "Ideas and Achievements," reports are published on: the DIAL aeronomy satellite; telecommunications in Ecuador; three new submarine cables into Spain; crossbar selectors, 50 years in the service of telephony. The section on "Union Activities" includes a report on the first I.T.U. seminar financed through the United Nations Development Program to be held in Latin America, at Caracas, Venezuela. The subject of the seminar was "Telecommunication management techniques and network planning in Latin America."

MEASUREMENT NEWS, January/February 1970. Published by Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146. Contents: HP opens new office in Canberra; Area manager for Victoria and Tasmania; 746A high-voltage amplifier; New mainframe and plug-ins for pulse system; Solid-state plug-in RF unit for sweep oscillator; Broadband fixed coaxial miniature attenuators; 7401B data recording system; Variable persistence X-Y display; Australian parts centre; 198A oscilloscope camera.

THERMOPHYSICAL PROPERTIES OF GASES AND LIQUIDS, V. A. Rabinovich, Editor, and A. Moscona, translator. **THERMOPHYSICAL PROPERTIES OF LIQUID AIR AND ITS COMPONENTS,** by A. A. Vasserman and V. A. Rabinovich.

Originally published in Russian by the U.S.S.R. State Service of Standard and Reference Data (GSSSD), these publications have been translated and published by the Israel Program for Scientific Trans-

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lations. Copies are available from the U.S. Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, U.S.A. as TT69-55091 and TT69-55092 respectively for $US3 each plus 75c postage.

These are the first of a series of systematic publications initiated by the GSSSD, designed to supply reliable information on the thermophysical properties of substances and materials and aimed mainly at the practical application of the reference data. The GSSSD was established in 1965 by the U.S.S.R. Council of Ministers. Its task is to co-ordinate and drecti researches into the properties of substances and mterials, involving the derivation, scientific analysis, and dissemination of reliable experimental and calculated data.

STANDARD TELEPHONES AND CABLES PTY. LTD., Moorebank Avenue, Liverpool, N.S.W., 2170, has available a two-volume catalogue of NEC power semiconductors which are now marketed in Australia by STC. The first volume, entitled "Low Power SCRs, Triacs and Power Control Devices," covers the range of small and medium current silicon controlled rectifiers, triacs, diacs, unijunction transistors, zener and reference diodes. and power control modules. The second volume, "High Powered Silicon Controlled Rectifiers and Rectifiers," covers the high current devices in the NEC range.

NEW DEVELOPMENTS, Issue B048, April, 1970. Published by Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney. 2000. Contents: E & M broadband amplifiers; Comark insulation meter; Waveline variable attenuator; Weinschel variable attenuators; Wandel u. Goltermann level meter; Kabelmetal coaxial cables; Magnetic AB noise figure meter; TRW 28V GHz transistors; Advance digital panel meters; Dana selective voltmeter; Kikusui 5in trigger oscilloscope.

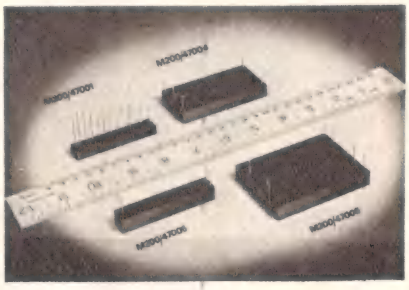
TECHNICAL NEWS BULLETIN, Vol. 54, No. 3, March, 1970. Published by the U.S. National Bureau of Standards. Inquiries to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, U.S.A. Contents: Derivative flame emission spectrometry; 1969 meeting of the International Committee for Weights and Measures; Hazardous product produced by electrical insulation; Testing program on vulcanised rubbers established; Changes in the U.S. unit of luminous flux; Engineers survey air tower accuracy; FIPS notes: Expanded laser beam used to analyse high intensity electric fields; Standards and calibration; NSRDS news: Conference briefs: Publications of the National Bureau of Standards.

PRODUCT GUIDE 1970. Published by the Electronic Engineering Association, Berkeley Square House, Berkeley Square, London W1X 6JU, England. The 20-page guide is intended as a quick reference to the leading companies in the British electronic capital equipment industry, to the wide range of products they manufacture, and to the services offered. Listing more than 180 general product categories, the guide makes no attempt to differentiate between the various competing products of respective members.

AMPEX CORPORATION, U.S.A., has published a series of new data sheets describing the composition and magnetic properties of Ampex ferrites for microwave applications. The ferrites are designed for use in such devices as circulators, isolators, phase shifters, and switches for low and high power requirements. Four classes of materials are described — lithium, nickel, magnesium, and garnets.

34590A WAVE ANALYSER RECORDINGS, Published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. The 20-page booklet describes a number of typical wave analyser applications with instrument connections shown on the page opposite an X-Y graphical recording of the result. Applications include measuring harmonic amplitudes, determining distortion, comparing filter characteristics, and audio frequency response recordings.

MATTHEY PRINTED PRODUCTS LTD., of the U.K., has published data sheets for a new range of "Silver Star" video delay lines for 625, 525, or 405 line colour television transmitting equipment. The data sheets show actual photographs



of in and out chrominance/luminance pulse and bar (2T luminance and 10T chrominance pulses) with minimal distortion after transmission through typical Silver Star delay lines. Three fixed modules replace bulky delay cable and equaliser circuits and give 75-ohm delays of 200nS, 500nS, and 1uS. Built-in equalisers give insertion loss/frequency response 0.7dB, 1.5dB and 2.6dB within 0.1dB respectively up to 5.5MHz. The modules plug in and need no adjustment. A fourth module can be programmed to give delays in 5nS steps from 5nS to 155nS, and can be cascaded with the others for longer delays. Inquiries to Matthey Garrett Pty. Ltd., P.O. Box 165, Kogarah, N.S.W. 2217.

RACAL AUST. REVIEW, Vol. 1, No. 3, Summer, 1970. Published by Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, N.S.W. 2113. Contents: Environmental testing, searching for perfection; Product news; Levelling the odds, Univac chooses Racal system; Omega, navigation system of the '70s; New offices.

VARIAN ASSOCIATES, U.S.A. Several divisions have produced publications which are available through Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W., 2065.

The Laboratory Electromagnet and Its Applications, published by the Analytical Instrument Division. Through simple qualitative discussions, the 37-page booklet explains the basic features of the laboratory electromagnet, its principle applications, and the terms which describe the electromagnet's performance. References are given throughout the text. The Division has also published a data sheet describing its series of 6in laboratory electromagnets.

The Solid State Division has published a 4-page brochure describing the range of

COLOUR TV SERVICING COURSES

E.I.L. Service Pty. Ltd., a subsidiary of Electronic Industries Ltd., is running a series of colour television courses at Electronic City, Rhodes, N.S.W., which are open not only to its own servicing personnel, but also to any interested persons including students from technical schools, colleges and universities.

The company has established a colour training auditorium at Electronic City which can accommodate 25 to 30 students. When not in use for instructional purposes, it is used for field testing of Astor colour receiving equipment. The colour equipment and the receivers were designed and built by Radio Corporation Pty. Ltd., another subsidiary of Electronic Industries. The receiver are of special modular design on open chasses, making all sections readily accessible for instructional purposes .

A course at present being conducted will continue for 18 months with two hours tuition per week. The time could be compressed to 10 or 11 weeks. It is intended to record the course on video tape and make this available to interested parties throughout Australia, together with equipment to play the tape back and Astor colour receivers for instructional purposes. The present course followed one on transistors and semiconductors which could also be taped if required.

Further information is available from the company's N.S.W. technical representative, Mr Gordon Campbell, phone Sydney 73 0211.

IMPATT high-power, single-diode oscillators. The 1W low-Q IMPATT oscillators are available in both fixed frequency and tunable versions in the range from 6 to 10GHz.

The Vacuum Division has published a brochure describing a fast-cycle vacuum system, the VI-460, suited for production coating work. The system operates with an array of oil-free pumps and is available both in automatic and manual models.

EMERSON AND CUMING INC., Canton, Mass. 02021, U.S.A., has published a 4-page folder describing 21 Eccomax HI-Q dielectric materials. The folder contains a property table as well as application notes and illustrations. The HI-Q line includes six casting resins, two impregnating resins two coatings, one adhesive, seven varieties of rod and sheet stock, and a low loss foam available in nine dielectric constants.

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, N.S.W. 2060, has published the following draft Australian standards, copies of which may be obtained, without charge from the various offices of the Association in all capital cities and Newcastle. Comment is invited from experienced persons and organisations, and should reach any office of the association no later than June 30, 1970.

Doc. 1526. Reliability of electronic equipment and components. It establishes principles and describes the basic concepts applying to reliability of electronic equipment and components, and to the establishment of reliability assurance programs.

Doc. 1525. "Approval and test" specification for bayonet lampholders. A revision of AS C117-1955 Ap., one of a series issued under Part II of the SAA Wiring Rules.

Docs. 1518 and 1527. Horizontal rectangular and cylindrical hospital sterilisers of the downward displacement pressure steam type. Based on British Standards 3219 and 3220 respectively.

Doc. 1528. Voltage transformers for measurement and protection. Complementary to AS C388, current transformers. When published, the two specifications will replace AS C45-1950, instrument transformers.

The Standards Association of Australia has also published the following Australian standards, copies of which may be obtained from the various offices of the association at the prices quoted.

AS C99. Lighting fittings for explosive atmospheres. Establishes requirements for the flameproof enclosure of lighting fittings which will enable their use in flammable or explosive atmospheres without risk of fire or explosion. Price $1.80.

AS C116. Rubber and rubber-like insulated cables and flexible cords. A revision of the 1967 edition, it has been widely amended to effect a comprehensive up-dating and to keep abreast of developments in the industry. Concurrently with the revision, the association has issued Amendment No. 1 to this edition. This withdraws certain sizes in the conductor range for 250V cables and varies the marking requirements. Price $3.60 including the amendment.

AS O117. Wood poles for overhead lines. The standard deals with the poles under three principal groupings: poles of species of timber which do not require full length preservative treatment, and poles of hardwood and of softwood species requiring full length treatment. Price $1.60.

AS Z43, Part II. One of a series dealing with audiometry and hearing aids, it establishes a reference zero for the calibration of pure tone audiometers. It applies to the sound pressure level corresponding to the threshold of hearing or monaural listening to pure tones at stated frequencies for standard reference earphones. Price 80c.

WATVIC SCIENCE RECORD, Vol. 5. Published by Watson Victor Ltd., P.O. Box 100, North Ryde, N.S.W. 2113. Contents: Hilger and Watts Infragraph; LKB reaction rate analyser; Orion chemical instruments; Toshiba X-ray diffractometer; Qualtex incubators; Mettler thermoanalyser; Caframo laboratory stirrer; Colora ultra-thermostats; Buchi rotary vacuum evaporators; LKB fraction collector; Corning glassware; Controlled Environments equipment; Carbolite muffle furnaces; Kerry ultrasonic cleaning system; Nikon microscope; Mettler microthermal instrument; Goertz multiscript instruments; Unigor multi-range meter; Krautkramer corrosion meter; Krautkramer ultrasonic flaw detectors; Buehler polishing cloths.

STC COMPONENTS REVIEW, First quarter, 1970. Published by Standard Telephones and Cables Pty. Ltd., Moorebank Avenue, Liverpool, N.S.W. 2170. Contents: NEC announcement; NEC quick reference; 20W fluorescent lamp dimmer; Pulse generator with variable frequency and duty cycle; NEC cross reference list; NEC replacement guide for SCRs; Industrial relay type SL7; Electronic ignition system; Panel form and unit-form 19-inch ISEP; ITT components handbook service; Passive components shortform catalogue; Printed circuit break switches; Insulated standoff.

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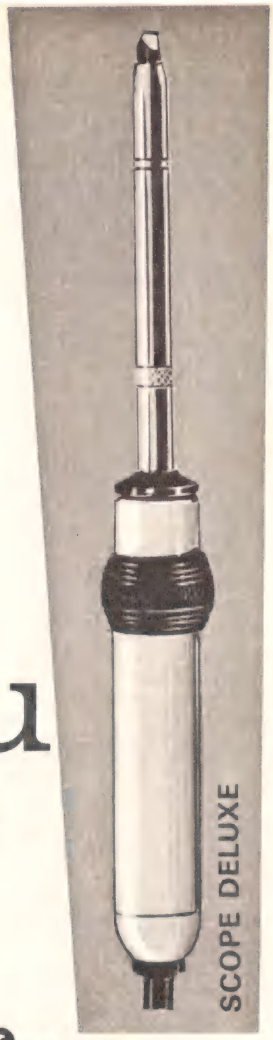

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AMATEUR BAND NEWS AND NOTES

Amateur contests and awards

There are very few hobbies that have not had an element of competition introduced, designed to give some tangible reward to participants. Amateur radio is no exception.

by Pierce Healy, VK2APQ

One of the popular activities among amateur radio operators throughout the world is participating in some type of contest organised either on an international basis or within their national or own localised area. The number of contests or awards is far too great to attempt to list them all in these notes. To cater for those interested in gaining awards, an International Award Hunters Club was established in 1957. This organisation is divided into six Continental Sections with headquarters in Finland. The headquarters keeps a register of world awards and certificates, published as the "A.H.C. Bulletin."

Details of the A.H.C. club may be obtained from the Australian Continental Secretary, who is A. Shawsmith, VK4SS, 35 Whynot Street, West End, Brisbane, Queensland 4101.

Contests and awards can be classified into two main categories: those where there are outright winners, and place getters in multi-contestant events; and those where awards are won for achieving specified goals. National societies and other organisations generally promote both types of events while individual groups, clubs or branches of national societies are concerned with the issue of awards for the achievement of specified goals, or events where there are no outright winners.

It is not intended to discuss the merits or weaknesses of this aspect of amateur radio activity, except to comment that any activity in its right perspective has its advantages and to participate for participation's sake can be a worthwhile activity. The nature of amateur radio contests are such that personal integrity is involved to a great degree, as well as the ability to construct, install and operate the technical equipment necessary for participation.

Some contests are of an endurance nature, requiring concentrated effort over a given period. Others require the utmost in patience while others have a sentimental value and are often held annually to celebrate some particular event or commemorate a particular person. Contests have been designed to cover all modes of emission on all amateur bands, and all forms of operation. There does not appear any one aspect of amateur radio communication that has not been catered for.

To maintain uniformity of achievement, some of the long term or continuing awards are set against schedules of recognised call areas. These listed call areas are updated continually and are published for information of prospective claimants. From time to time such lists have been included in these notes.

The Australian DX Century Club Country List issued by the Wireless Institute of Australia will be published next month. This list has been updated to March 10, 1970, and has been issued on behalf of the Institute by Geoff Wilson, VK3AMK, Federal Awards Manager.

Also to be published are the rules for the Australian DX Century Club Award together with details of some of the overseas awards. Also the rules for the Australian VHF Century Club Award.

Current awards that are receiving the attention of amateur operators throughout the world are the Australian and New Zealand Cook Bi-Centenary Awards to commemorate the voyage of Captain James Cook to the shores of both countries, by the Wireless Institute of Australia and the New Zealand Association of Radio Transmitters.

To illustrate the importance being placed on contests using the media of communication by members of the amateur service, a new contest was introduced last month to celebrate the second "World Telecommunications Day."

Unfortunately the details were not received from the International Telecommunication Union in time to enable the details to be published before the event, which was held on May 17. No doubt some operators had heard about the event from other sources and were able to participate.

This contest was sponsored by the Brazilian Ministry of Communications, who expressed the hope that the Telecommunications Administration of the country which gains the I.T.U. trophy in the 1970 contest will also sponsor a contest to commemorate World Telecommunication Day. In addition to the trophy, gold, silver and bronze medals will be awarded to the highest scoring radio amateurs in the world, and diplomas will be awarded to the highest scorers in each country.

Some of the contests to be held later this year are: The N.Z.A.R.T. Memorial Contest, on 80 metres, July 4 and 5. The W.I.A. Remembrance Day Contest, all bands, August 15 and 16. The W.I.A.-N.Z.A.R.T. VK/ZL Oceania DX Contest, all bands, October 3 and 4 phone section; and October 10 and 11 CW section. The Radio Society of Great Britain 7MHz DX contest October 24 and 25 CW section; November 7 and 8 phone section. The W.I.A. Ross A. Hull VHF Memorial Contest, December 5 to January 11, 1971.

A summary of a few of the awards promoted by various bodies around the world follows:

N.Z.A.R.T. North Shore Branch Award: To commemorate the first international OK Dinghy Championships to be sailed in New Zealand Waters, Branch 29 (North Shore) New Zealand Association of Radio Transmitters is offering "The North Shore OK Dinghy World Championships 1970 Award" to all amateur radio operators who contact five members of the branch during October, 1970.

Any band and any mode may be used. Log details of contacts in support of claims should be sent to J. K. Coadet, ZLIFZ, 183 Lake Road, Takapuna, Auckland, 9, New Zealand.

Radio amateurs in countries competing in the championships are invited to make schedules with North Shore Branch stations during the events which are being sailed off Takapuna Beach in October, 1970.

Worked All Malaysia Award: This award is promoted by the Malaysian Amateur Radio Transmitting Society.

Applicants must supply details of 10 VS1/9V1/9V0, 10 VS2/9M2, one VS4/9M8, one VS5 and one ZC5/9M6 making a total of 23 contacts.

Log data, certified by two officers of the applicant's local club or society who have checked the QSL. cards, should be sent to the Hon. Secretary, M.A.R.T.S., P.O. Box 777, Kuala Lumpur, Malaysia.

A fee of 10 IRCs must accompany the application.

Manitoba "VE4" Centennial Award: To celebrate the centenary of Manitoba, the Amateur Radio League of Manitoba have created a special award for amateur operators who achieve the following requirements:—

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

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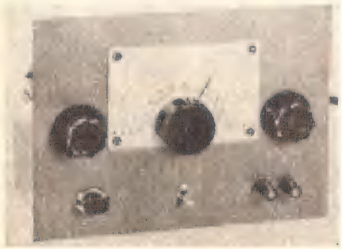

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a. Contestants must accumulate 100 points.
b. W/K, XE and VE/V0 stations receive two points per contact.
c. Stations in all other call areas will receive five points per contact.
d. A contact consists of the exchange of signal reports.
e. Contacts may be made on each band.
f. Contacts may be made on different modes on each band.
g. Cross-mode contacts are not allowed.
h. Two different members of the Amateur Radio League of Manitoba will be designated "Bonus Stations" each month. Contacts with these stations will be worth double points.
i. QSL Cards are not required.
j. Time limit for the Manitoba Centennial Award is January 1, 1970, to December 31, 1970.

Contestants for the award should send a copy of their log and two IRCs to:

J. N. KNOWLES, VE4JK,
Box 365 G.P.O.,
Carman,
Manitoba,
Canada.

Worked all Winnipeg Award, Capital of Manitoba: The Worked all Winnipeg Award is sponsored by the Winnipeg Amateur Radio Club.

The Award will be issued to any licensed amateur radio operator who makes two-way contact with 15 stations located in the city of Winnipeg.

No QSL cards are required.

Send a copy of log showing details of contacts made to:—
Anne S. Gray, VE4NS,
110 Voyageur Avenue,
Winnipeg 22,
Manitoba, Canada.

The Brandon, Manitoba, Wheat City Award: This award is sponsored by the City of Brandon and the Brandon Amateur Radio Club.

All contacts made since January 1, 1967 are eligible.

Log data only required.

Contacts may be made on any amateur band any mode — CW; AM; SSB. One IRC or equivalent must accompany each application. Stations in Canada, U.S.A. (Alaska included), Mexico must make two-way contact with five amateur radio stations in the city of Brandon.

Stations located in all other areas, including Central America and Hawaii, must make two-way contact with three amateur radio stations in the city of Brandon.

Brandon call signs to look for are — VE4s AO; AU; CI; CT; DQ; EL; BS; UP; JT; OZ; RW; XN; YC; JF; FW; AL; KN; GV; KZ; QZ; YW; RE; MQ; YM; SR; FD.

Send applications to:—
Doug Bowles, VE4QZ,
1104 1st Street,
Brandon,
Manitoba, Canada.

Jerusalem Award: To gain this award it is necessary to send proof of two-way contact made with seven Israel amateur radio stations.

At least two of the contacts must be made with stations located in Jerusalem.

Contacts may be made on any amateur band using any mode.

Contacts must have been made after May 15, 1948.

Send verified extract from log showing details of contacts made, together with two IRCs to :—
4X4SO,
21 Hahisgah Street,
Jerusalem, Israel.

The Okinawa Award: This award is available to amateur radio operators and shortwave listeners who have received confirmation of contacts or reports from five KR8/KR6 amateur stations. Applicants from the following call areas will need 10 confirmations: BV; CR9; DU; HL; JA; KG6; VS6 and W.

A log extract certified by two amateurs (or an official of a recognised radio society) who have seen the SQL cards should be sent to:—
Okinawa Amateur Radio Club,
APO, San Franscisco,
California, 96331, U.S.A.

There is no fee and the QSL cards need not be submitted.

Jubilee Award: To gain this award it is necessary to make two-way contact with 25 U.S.S.R. amateur radio stations located in the 1; 2; 3; 4; 9; and 0 call districts.

Contacts must be made between January 1, 1970 and December 31, 1975.

Any amateur band may be used and contacts may be made using any authorised mode of transmission.

When making application for the award, send a log extract verified by the national amateur radio society to:—
Central Radio Club of U.S.S.R.,
Box 88,
Moscow.

Applications must be made before March 31, 1976.

WIRELESS INSTITUTE ACTIVITIES

Many requests have been received from readers for information regarding where they may contact the Wireless Institute of Australia. The following are the postal addresses in the various States. Only in New South Wales and Victoria are offices open during normal business hours, when inquiries may be made by telephone.

New South Wales:
W.I.A., New South Wales Division, Wireless Institute Centre, 14 Atchison Street, Crow's Nest, N.S.W. 2065. Telephone 43 5795.

Victoria:
W.I.A., Victorian Division, 478 Victoria Parade, East Melbourne, Victoria 3002. Telephone 41 3535.

Queensland:
W.I.A., Queensland Division, Box 638, G.P.O., Brisbane, Qld. 4001.

South Australia:
W.I.A., South Australian Division, Box 1234K, G.P.O., Adelaide, S.A. 5001.

Western Australia:
W.I.A. Western Australian Division, Box N1002; G.P.O., Perth, W.A. 6001.

Tasmania:
W.I.A., Tasmanian Division, Box 851, G.P.O., Hobart, Tasmania 7001.

Antenna Construction

The never-ending discussions on antenna design and construction has brought forth some very ingenious ideas and methods, not to mention the differing opinions expressed regarding the respective merits of Yagi and quad antennas.

One of the major problems in constructing a multi-band quad antenna is the design of the boom or means of supporting the spreaders so that the most efficient spacing between elements on all three bands may be achieved.

This problem has been overcome by a two piece cast aluminium hub designed by Syd Clark, VK3ASC. In an article "A Hub for Tri-Band Spider Quads," published in the March, 1970, issue of the W.I.A. magazine "Amateur Radio," Syd describes his experiments and subsequent design of the hub. The article aso gives instructions for the construction and assembly of a three-band quad.

The hub is being produced on a commercial basis, and is available for $15 plus $1 for packing and postage within Australia. Further details may be obtained from: Syd Clark, 26 Bellevue Avenue, Rosanna, Victoria. 3084.

Slow Scan Television

The Postmaster-General's Department has approved the use of slow scan or narrow band television on all amateur bands as presently authorised in Australia.

The standards to be used are entirely at the discretion of the individual amateur operator, although the bandwidth of such emissions shall not exceed that of an A3 single-sideband or double-sideband signal.

Where A3 or A5 emissions are used simultaneously on the same carrier frequency, the total bandwidth shall not exceed that of an A3 double-sideband emission.

Identification is to be by call-sign in visual form on the televised picture and by telegraphy or telephony on the sound channel.

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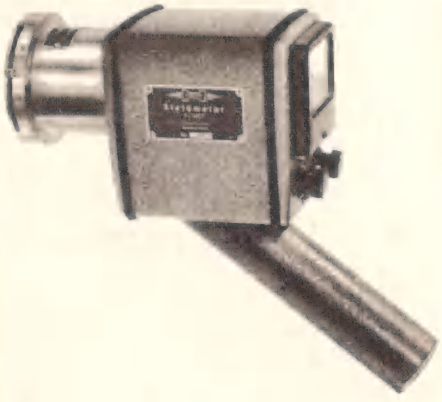

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NEW SOUTH WALES

At the May meeting of the New South Wales Division, held at Wireless Institute Centre, 14 Atchison Street, Crow's Nest, Mr C. G. McCue, Assistant Director of the Ionospheric Prediction Service Division, Commonwealth Bureau of Meteorology, gave a most interesting and informative lecture on ionospheric propagation. Mr McCue explained that the services provided by the I.P.S. Division have been grouped under the following headings:

a. Predictions for normal communication.

b. Disturbance warnings and allied services.

c. Ionospheric and allied data.

d. Other Services.

He said Australia was well to the forefront in the world in ionospheric research. The lecture covered many phases of the research work being done and included a clear and easily understood explanation of the effects solar flares and other phenemonen have on world wide radio communication.

Mr McCue, suggested that amateur radio operators could provide a lot of useful information on fadeouts and other anomalous effects on radio propagation, and he would welcome any co-operation from interested persons. It was pointed out that reports would of necessity have to be in a form and duration that would meet the requirements of the I.P.S. data collecting centre. To this end he would be pleased to give further information.

A limited number of Handbooks for use with the Ionospheric Prediction Service were made available to the institute library, and in future issues of these notes extracts of interest to amateurs will be given.

Central Coast Branch

The Central Coast Branch of the N.S.W. Division meets on the third Friday evening each month, when, in addition to general discussion relating to club activities, members are entertained with a lecture on a topical subject associated with amateur radio. A recent lecture was on VHF, mobile equipment using ex-taxi FM mobile units converted for amateur band operation. This interesting subject was covered by Ross Mudie, VK2ZRQ.

The new club room at Kariong, located near the Woy Woy turnoff on the Pacific Highway just south of Gosford, should be occupied by the time these notes are read.

The Club Publicity Officer is Len Brennan, VK2AMU, 2 Trelawney Street, Killarney Vale, 2262.

Illawarra Branch

The office bearers for the next 12 months are:—

President: Don Reynolds, VK2ZRK.

Vice-president: Eric Fisher, VK2DY.

Secretary: Hank Laauw, VK2BHL.

Treasurer: Alan Ward, VK2VH.

Additional committee members:—

Graeme Douse, VK2AGV.

Roger Evans, VK2BRE.

Lyle Patison, VK2ALU.

Brian Tucker, ——

Auditor: Basil Dale, VK2AW.

Area Officer and Correspondent: Lyle Patison, VK2ALU.

An important matter was introduced at the March meeting, when a motion was moved that — "the committee of the Illawarra Branch of the Wireless Institute of Australia investigate the possibilities of obtaining a clubroom for its members, at which a permanent meeting place could be established and the activities and growth of the club extended."

A number of advantages were given for such a move and it was decided to give all members the opportunity to vote on the proposal at a later meeting.

A current project of Illawarra Branch members is the reconditioning of a radio telescope at Dapto. When completed, UHF moonbounce and other experiments will be carried out. Beam width checks of the antenna system, using the sun as the source of noise and a FET 432MHz converter, have proved most encouraging.

The Branch also conducts an A.O.C.P. class for those in the Wollongong and nearby areas desirous of obtaining their amateur licence. Full details of the course and other activities may be obtained from the Secretary, 443 William Beach Road, Dapto, N.S.W. 2530.

QUEENSLAND

At the annual general meeting of the Queensland Division of the W.I.A., held late in March, Norm Wilson, VK4NP, presented a comprehensive report on the Division's activities during the preceding year. The report indicated that, although there had been an increase in members during the year which had more than offset any loss due to non-payment of subscriptions and transfers interstate, it had been found necessary to increase city, country and associate membership subscriptions by $1 per annum. This increase will become effective from March 1, 1970. The subscription rates for clubs, student members and pensioners remain unchanged.

Office bearers for the current year are:— President: Norman Wilson, VK4NP, Vice-president: Theo Marks, VK4MU, Honorary Secretary: Bill Bentson, VK4QF, Honorary Treasurer: Charles Taylor, VK4UC, Federal Councillor: Lawrie Blagbrough, VK4ZGL, Convention Organiser: Bill Flannery, VK4XO, Library Officer: Ron Guttormsen, VK4RL, Inward QSL Officer: Harry Scholz, VK4HR, Outward QSL Officer: Bill Jehn, SWL4001, Station Manager: Harold Bremerman, VK4HB, QTC Editor: Les Brennan, VK4XJ, Student Class Organiser: Sid Carter, ——.

VK4 Convention

The Annual Convention of the Queensland Division will be held on June 13 and 14, 1970, at the R.S.L. Club, Sandgate. This is the first time for several years that the convention has been held in the Brisbane area. The facilities available at the convention site are first rate, and country members making the trip will surely find it worthwhile.

Registration fees as follows:

Members	$3.50
Wife or Friend	$2.50
Children, each	$1.50

This fee will include Saturday night dinner and entertainment. To encourage early registration, the committee has decided to donate a prize of a valu-

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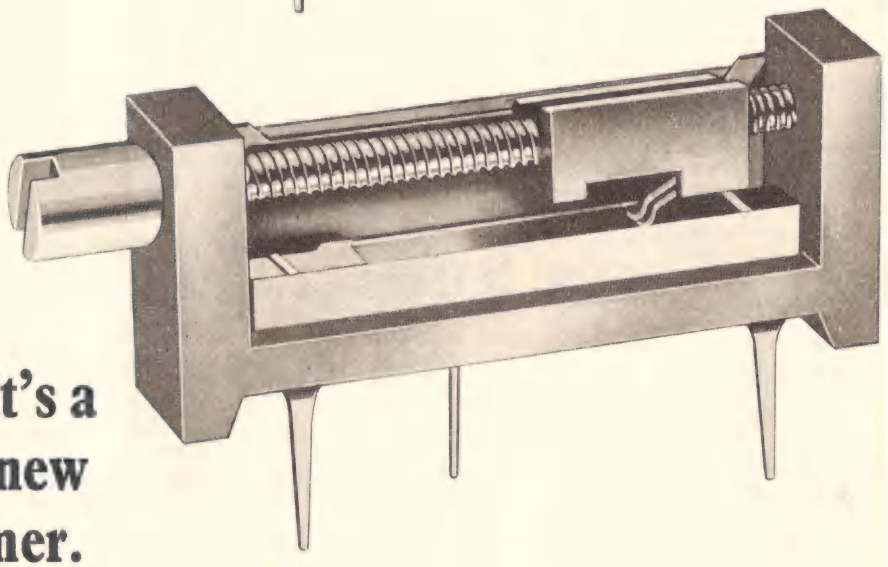

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able stereo tape recorder, the winner will be selected at the convention from receipt numbers issued up to the cut off date, June 5, 1970.

All registration applications should be sent to the Convention Organiser: W. Flannery, VK4XO, 71 Wishart Road, Mt. Gravatt, Brisbane. 4122, Qld.

YOUTH RADIO CLUB SCHEME

Westlakes Radio Club: The annual general meeting of the Westlakes Radio Club was held on Friday, March 13. In his report, the outgoing president referred to the generosity of Bill Hall, VK2XT, who had made available on most reasonable terms, the premises now being used as the club rooms. Plans for classroom accommodation, workshop facilities and club station transmitting room were outlined, as was the drive to increase the membership in 1970 to the 200 mark.

The excellent club record for the past year was outlined, during which time the following certificates were gained by members:

Elementary Certificates: 6 honours grade, 10 credit grade, 3 pass grade.

Junior Certificates: 2 honours grade, 2 credit grade.

Intermediate Certificates: 2 credit grade.

Radio Telephony Certificate: 1 grade 3.

Amateur Operators Certificates: 4 limited licences, 1 full licence.

Officers elected for the current year are: President: Keith Howard, VK2AKX; vice-president: Joe Waugh, VK2IQ; secretary: Eric Brokbank; treasurer: Max McLachlan; communications officer: David Russell, VK2BSC; assistant comm. officers: Brian Jones, VK2ZHF; Ian Miller, VK2BJT; Morse code training officer: Joe Waugh, VK2IQ; assistant: Ken Cunningham, VK2BSL; stores officer: Ray McCook; assistant stores officer: Daryl Boyce; canteen officer: Kevin Scully; transport co-ordinator: Ray McCook; committee of management: Bill Hall, VK2XT; Pat Maloney, VK2AXU; Bruce Morley, VK2ZNB; Frank Boundy, VK2ZFX; Gordon Sutherland, VK2ZSG; Stan Lloyd, VK2AYL; Wal Lean, Norm Judd, John Dove.

Maitland Radio Club: As its contribution to the Captain Cook Bi-Centenary Celebrations, the Maitland Radio Club held an "Open House" to the general public, from April 17 to May 1, 1970. At this, members entertained visitors, and explained the club's activities, also its plans to increase the size of the building to provide additional storage space and classroom facilities.

Progress is being made with the amateur television experiments. Under the leadership of Des Mills, the group has transmitted test pictures over a distance exceeding 10 miles, using a 15-watt transmitter. A portable/mobile receiving station has been used to check signal strength in the surrounding districts.

A special award for radio amateurs throughout Australia who make the required number of contacts with the Maitland Radio Club members is to be instituted, commencing June, 1970. The award has been approved by the Maitland City Council and is to be known as "The Maitland City Award." Details will be given as the final rules come to hand.

Two members, Messrs E. Berman and K. Murray, gained passes at credit level at a Junior Certificate examination held in April.

The club's newest member is Reverend Father Mulhearn, of Saint Pius College, Adamstown.

All India Amateur Radio Convention

Due to the lack of space the transcript of two important speeches were held over from last month's notes. The sentiments expressed both by the Minister of State for Communications and the Secretary, Department of Communications, indicate the status that amateur radio is given in India and the desire to see a flourishing Amateur Service in that country.

From these speeches it will be seen that the reorganisation of the amateur service in India is to receive sympathetic support by governmental bodies. It would appear fitting for Amateur Radio Societies throughout the world to give whatever assistance may be requested by the Ad Hoc Committee charged with the formation of a Federal National Body and so ensure that the amateur service in India can be fully represented on the international scene, particularly in the International Amateur Radio Union as a member of the Region III Association.

Speech by Professor Sher Singh, Minister of State for Communications, at the inauguration of the Convention.

I am very glad to have this opportunity to address all of you who have gathered here today under the auspices of various amateur radio clubs in India. I am thankful to the organisers for giving me this opportunity to address the radio amateurs on the occasion of the first All India Amateur Radio Convention.

I understand that amateur radio activities started around 1908. Along with the growth of radio communications it has expanded steadily. Amateur activity in India also is on the increase continuously and it is in the fitness of things that the First All India Amateur Radio Convention is held in Bombay, where there is a large concentration of amateurs. Amateur radio provides a medium of self training and widespread assimilation of developing and testing new techniques and technology in radio communications. In the economic field this activity can provide a boost to the radio industry by way of requirements of the different types of equipment and components.

My Ministry has been encouraging this excellent scientific hobby. On demand from many amateurs, the Grade II category of amateurs was introduced to encourage beginners to take up the hobby and gradually get into the higher category. Recently, as you all know, the age limit for the granting of amateur licences has been reduced on the suggestions of the amateur clubs and now it is possible for students from the early age of 14 years to join this fraternity. Further, the transmitter power permitted to amateurs was increased by 50 per cent. In addition, the amateurs are permitted the following facilities:—

(a) Amateurs can get their licence renewed for a period of three years instead of one year.

(b) They can make their payment of fees by postal orders instead of through challans and treasury receipts.

(c) Experiments on very high frequencies are also freely permitted.

I am glad to know that the amateur societies and the clubs are helping by bringing out publications, periodicals, etc., for the benefit of radio amateurs

(Continued on page 171)

SOUTH AUSTRALIA

The Annual General Meeting of the Y.R.C.S. South Australian Division will be held on Saturday, June 20, 1970, at the Kadina Methodist Church, 3 Hay Street, Kadina, S.A., between 10.00 a.m. and 4.00 p.m.

This meeting will provide an opportunity for leaders of Youth Radio Clubs to meet and discuss topics of common interest. Any person interested in forming a new club, or in acting as a correspondence group leader, is welcome to attend.

During the Easter holiday weekend amateur radio was used to demonstrate a communication link for the Boy Scouts Association on their annual Easter Hike in the Mairne Valley, north of Adelaide. Three stations took part in the event. A six-metre station operated by Alan Raftery, VK5ZBT, was located at the base camp at Eden Valley; while Allen Dunn, VK5FD, and Steve Johnston, VK5ZNJ, operated HF and VHF stations at check points along the route.

During the day, many Scouts visited the stations and had an opportunity to speak to fellow Scouts and rangers at the base camps.

On Sunday, April 26, two stations operated by VK5FB on 14MHz single-sideband and VK5ZNS on 52MHz AM, were located at Woodhouse, a Scout camp in the Adelaide Hills. These stations demonstrated amateur radio and publicised the Youth Radio Club Scheme.

Other details of Y.R.C.S. activities, including details of the Y.M.C.A., Unley High School, Mitchell Park and Elizabeth Youth Radio Clubs will be included in next month's notes.

TASMANIA

The Friends School Radio Club was formed about 12 months ago by Mr C. Norman, a science teacher on the school staff. Since the formation of the club, three students have gained their Elementary and Junior Certificates.

Passes in the Junior grade were gained by:

Barrie Hoskins, Pass;
Rodney McGee, Credit;
Neil Wellington, Credit.

The success of these students accounted for half of the Junior certificates issued in Tasmania during 1969.

MIDWINTER VHF-

The contest committee of the N.S.W. Division W.I.A., VHF and TV Group invites all amateurs and shortwave listeners with VHF and/or UHF equipment to participate in the 1970 midwinter contest. This contest will be held during the Queen's Birthday holiday weekend in June.

Awards will be made as stated in Rule 5, and scores from all accepted entries will count towards the Annual Chairman's Trophy of the N.S.W., VHF and TV Group, on a pro-rata basis.

OBJECTS: Amateur operators in the VK2 and VK1 call areas will endeavour to contact as many other amateur stations as possible and over as great a distance as possible. Contacts may be made on any one or more of the authorised Australian amateur bands from 52MHz and above.

The "Incentive Rating" tables introduced last year, give a scoring advantage increasing with the use of the tunable VHF bands, the UHF and SHF bands and amateur television.

DATE/DURATION: Contest commences Saturday 13/6/70 1400 hours E.S.T. and ends Monday 15/6/70 1200 hours E.S.T. with rest periods.

The operating times are:

Saturday 13/6/70, 1400 hours to 2200 hours (8-hour period).

Sunday 14/6/70, 0800 hours to 1100 hours (3-hour period).
1200 hours to 2200 hours (10-hour period).

Monday 15/6/70, 0800 hours to 1200 hours (4-hour period).

The rest period on Sunday between 1100 and 1200 hours is for the VK2WI broadcast.

RULES:

1. There are two time divisions for which entries may be submitted. Division "T" for the total, or overall, contest duration and Division "S" for the best scoring six consecutive contest hours. These may, if desired, be broken by one of the rest periods, e.g. from 2000 hours to 2200 hours Saturday 13th, then 0600 hours to 1000 hours Sunday 14th. Similar periods are acceptable as six consecutive hours.

2. Entries may be submitted for either Division "T" (total) or Division "S" (six hours), or both. But, the winner of Division "T" will not be eligible to also win Division "S."

3. The various classes in which participants may enter are:
Class "H" Home station.
Class "M" Mobile station.
Class "P" Portable (field) station.
Class "SWL" Listener, home station.
A station may enter in more than one class if satisfying the conditions; e.g. he could work from home, then go mobile and then portable.

4. Combining the divisions and classes, gives the following different sections available to contestants:
Section HT Home station total period.
Section HS Home station six-hour period.
Section MS Mobile station six-hour period.
Section PT Portable station total period.
Section PS Portable station six-hour period.
Section SWL Listener home total period.

5. AWARDS: Will be made to the winners of the above sections for each of the following four bands: 52MHz; 144MHz; 420/576MHz; 1215-MHz and above.
Entry forms should be clearly marked in the block provided, showing bands used in each section. A special prize will be awarded to the outright highest scorer in the whole contest in addition to any other awards the same entrant may win.
As well as the awards mentioned, a MERIT Award will be made for the best entry submitted by an operator who has held a call sign for 12 months or less.

6 A PORTABLE STATION is defined as being one at a field location, not using normal car antennae and at least one mile from the home QTH of any operator of that station. Use of AC mains is permitted but the station must not be at the home of another amateur operator.

7. A MOBILE STATION is defined as one whose equipment, power source and antenna are wholly mounted in or on the vehicle, which is capable of being driven with the equipment operating. The vehicle need not be moving and it may be at any location. Maritime and airborne mobiles score the same as normal mobiles.

8 CROSSBAND OPERATION is permitted as is the arranging, during contest hours only, of contest contacts. For this contest the use of HF bands is not permitted for the arranging of contest contacts.

9. NET FREQUENCY CONTACTS score as part of the band containing them and not on an individual net basis. That is, six metre nets score as part of the six metre band score and the two metre nets as part of the two metre band score.

10. Contacts via repeaters and translators can NOT score in this contest but such contacts may

UHF CONTEST

be used for arranging, during contest hours only, of contest contacts. As with direct net operation, operators should have due regard for the etiquette and importance of net operation.

11. One scoring contact per station is allowed in every one "clock hour" for each band a station can work. One contact per "clock hour" means one QSO between say, 1300 hours and 1400 hours. It is not necessary to wait a full hour to have a second scoring QSO with the same station on the same band. E.g., "A" works "B" at 1259 hours; they may then work again any time from 1300 hours to 1359 hours, with their following QSO between 1400 hours and 1459 hours, and so on.

11a. A mobile station may work the same station within the hour period providing he has increased his distance from that station by more than 10 miles since his last contact.

12. If two stations have a scoring contact on one band then in the same "clock hour," have a contact on another band, both these contacts are allowed to score. If only one station can transmit on the other band and they have a cross-band contact this is allowed to score, but, where both stations can transmit on the band, cross-band contacts do NOT score. Any two stations may therefore have several scoring contacts in each "clock hour" if they use several bands.

13. In Section SWL all scoring contacts heard can be logged; the hour rule does not apply in this section of the contest.

14. SERIAL NUMBERS must be exchanged as usual before points may be claimed for a contact. The five or six digit serial number to be the R/S report for phone or R/S/T for telegraphy followed by three digits commencing as shown below and increasing by one for each successive scoring contact.

For all 52MHz band contacts commence at 601.

For all 144 MHz band contacts—commence at 201.

For all 420MHz band contacts — commence at 401.

For all others including ATV—commence at 001.

Note: — Serial numbers for contacts on net frequencies are to be in the same sequence as for the band they are in.

15. ATV STATIONS. The same serial number is to be sent over the video transmission as is sent over the audio transmission.

16. LOGS are not required but may be sent in with the entry. In any case they should be made available to the contest committee if requested. Entries are to be set out in the form shown in Figure 1. This will enable the contest committee to finalise the results and compile the statistics quickly. Please check entries for completeness and accuracy before submission. For cross band contacts, record contact number under the band transmisison was made.

17. ENTRIES should be sent in so as to reach the Secretary, VHF/TV Group, Wireless Institute Centre, 14 Atchison Street, Crow's Nest, N.S.W. 2065 by Friday night 17/7/70.

If requested and as time permits, the Contest Committee will assist with the preparation of an entry. In this way it is hoped to ensure a large return of entries.

18. INCENTIVE RATING and MULTIPLIER: The various bands and operating possibilities have been broken up into categories for the application of an "incentive Rating," from which an operator can derive the multiplier for each contest contact.

To obtain the multiplier for a contact, take the rating for your own station — from the rating table given — and add to the rating of the station worked. This sum is called the multiplier. The same multiplier therefore applies to both stations in any one contact.

19. DISTANCE POINTS are based on the airline separation of the two stations in contact and accrue at one point for each ten miles or part thereof, on any frequency. The minimum distance for scoring is one mile, e.g. 1 to 10 miles — one point; 50 miles — 5 points; 51 miles — 6 points, etc.

20 SCORE CALCULATION for each contact is made by multiplying the distance in miles by the multiplier, derived from rule 18. Example: A home station operating on a 52MHz net frequency, rating of one from table, has a cross-band contact over a 50-mile path with a 432MHz ATV portable station, rating of 10 x 2 eq. 20. The multiplier for each of these stations is the sum of their ratings—1 plus 20 eq. 21. Applying this multiplier of 21 to the distance points gives 5 x 21. A score of 105 is therefore earned by both of these stations for the contact.

The total score for a division is the total of all the individual scores in that division.

21. SECTION SWL. The distance points are based on the airline distance from the station heard on the listeners location, and the multiplier is the straight out rating of the station from the table.

22. ATV STATIONS. The audio channel may be on any band. 144MHz or higher, the rating being based only on the band used for the video channel.

23. IMPORTANT NOTE. Only one call sign may be used from any one station.

24. Each participant must operate within the terms of his/her licence, abide by the rules of the contest and sign the declaration at the foot of the entry form.

TABLE OF INCENTIVE RATINGS AND MULTIPLIERS

Category	Rating	52MHz and 144MHz Nets Home/Port/Mob.	52MHz and 144MHz Bands Tunable Home	52MHz and 144MHz Bands Tunable Port/Mob.	70cm (438MHz) Net Home	70cm (438MHz) Net Port/Mob.	420MHz and 576MHz Bands Home	420MHz and 576MHz Bands Port/Mob.	1215MHz Band Home	1215MHz Band Port/Mob.	2300MHz to 10GHz Bands Home	2300MHz to 10GHz Bands Port/Mob.	21GHz Band Home	21GHz Band Port/Mob.
52MHz and 144MHz Nets Home/Port/Mob.	1	2	4	5	4	5	10	11	16	17	20	21	23	24
52MHz and 144MHz Bands Tunable Home	3	4	6	7	6	7	12	13	18	19	22	23	25	26
52MHz and 144MHz Bands Tunable Port/Mob.	4	5	7	8	7	8	13	14	19	20	23	24	26	27
70cm (438MHz) Net Home	3	4	6	7	6	7	12	13	18	19	22	23	25	26
70cm (438MHz) Net Port/Mob.	4	5	7	8	7	8	13	14	19	20	23	24	26	27
420MHz and 576MHz Bands Home	9	10	12	13	12	13	18	19	24	25	28	29	31	32
420MHz and 576MHz Bands Port/Mob.	10	11	13	14	13	14	19	20	25	26	29	30	32	33
1215MHz Band Home	15	16	18	19	18	19	24	25	30	31	34	35	37	38
1215MHz Band Port/Mob.	16	17	19	20	19	20	25	26	31	32	35	36	38	39
2300MHz to 10GHz Bands Home	19	20	22	23	22	23	28	29	34	35	38	39	41	42
2300MHz to 10GHz Bands Port/Mob.	20	21	23	24	23	24	29	30	35	36	39	40	42	43
21GHz Band Home	22	23	25	26	25	26	31	32	37	38	41	42	44	45
21GHz Band Port/Mob.	23	24	26	27	26	27	32	33	38	39	42	43	45	56

Rating for amateur TV (black and white): The rating of the band used for the video channel multiplied by two.

To find the multiplier for a contact, ADD the ratings of the two stations -- OR -- on the above chart select the horizontal row corresponding to the category of one station. Then select the vertical column for the category of the other station. The multiplier for that two stations is the number shown at the intersection of the two lines.

Specimen Entry Form

Midwinter VHF - UHF Contest

Call Sign Used .....

Location .....

Operators Names and Call Signs .....

.....

.....

If in Division "S" - 6 hours: From ..... hrs on .....

To ..... hrs on .....

Place Band Name in Sections Entered 52MHz; 144MHz; 432MHz; etc.

Division / Class	"T"	"S"
H		
M		
P		
SWL		

Category	Mark "X" for Categories		Est. RF Pwr. Out, Mode	Antenna. Type-Size-Height.	Division "T"		Division "S"	
	Transm'd	Rec'd			Number Contacts	Score Claim	Number Contacts	Score Claim
52MHz Net								
52MHz Tunable								
144MHz Net								
144MHz Tunable								
70cm (438MHz) Net								
420MHz to 576MHz								
1215MHz								
2300MHz to 10GHz								
21GHz								
420MHz ATV								

Comments and suggestions:

Declaration: I hereby certify that I have operated in this contest in accordance with the conditions of my licence and abided by the rules of the contest.

Signed ..... Call Sign ..... Date .....

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Lubricant: Lubricates even the most delicate mechanisms; non-gummy, non-sticky; does not pick up dust or dirt.
Penetrant: Penetrates to loosen frozen parts in seconds.
Volume Resistivity per ASTM D-257; Room temperature, ohm/cm; 1.04×10^{12}
Dielectric Constant per ASTM-877:
Dielectric Constant 2.11 Dissipation Factor: 0.02
Dielectric Strength per ASTM D-150:
Breakdown Voltage 0.1 inch gap.32,000 volts
Dielectric Strength volts/inch 320,000 volts
Flash Point (Dried Film)
Fire Point (Dried Film) 900 degrees F
TESTS AND RESULTS: 950 degrees F
Lawrence Hydrogen Embrittlement Test for Safety on High Tensile Strength Steels: Passed. Certified safe within limits of Douglas Service Bulletin 13-1 and Boeing D6 17487.
Mil Spec. C-16173D-Grade 3 Passed
Mil Spec. C-23411 Passed
Swiss Federal Government Testing Authority for Industry: Passed 7 Day Rust Test for acid and salt water. Passed Weiland Machine Test for Lubricity as being superior to mineral oil plus additives.

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and for giving information to new and prospective amateurs. I am glad to know that amateur clubs are helping beginners to start in the hobby with the supply of know-how and materials.

This does not mean that I am not aware of the difficulties brought by the amateur societies to the notice of the Government from time to time. Here I am referring to the time schedules for the issue of licences, permission for temporary shiftings, for field days and such other items. The different procedures are under constant review, so that the difficulties of the amateurs are eliminated. The clubs have been pressing the Government for release of surplus disposal equipment from Government sources. The individual clubs can approach disposal authorities for release of disposal wireless equipment in their favour.

I am sure that with the guidance of the veteran amateurs, amateur societies and with the interest now being shown by the younger generation in this hobby, the activities will increase manifold. I am glad to know that undergraduates in colleges and technical institutes are coming forward to take an interest in this activity. The various activities in the field of telecommunications require devoted work. Economic and social development of any region goes hand in hand with the development of telecommunications.

More equipment and above all more technicians are needed to meet the growing needs in the field of communications. I am sure our amateurs will not lag behind in making their own contributions in the field of telecommunications.

Speech by Shri N. C. Srivatsava, I.C.S. Secretary, Department of Communications, on December 30.

I thank you for giving me this opportunity to be in your midst today at the concluding session of the First All India Amateur Radio Convention. I understand that the discussions at your convention have been very fruitful. I am sure that the discussions will go a long way to help the fraternity and lead to better understanding of the problems facing amateur radio activity in India.

I trust you have defined the areas in which solutions have to be found urgently. I am sure Government would examine the conclusions reached by the Convention sympathetically and attempt to remove any difficulties which may be standing in the way of legitimate growth of radio amateur activity in India.

As has been observed, the number of amateurs in India is still very insignificant, especially when we take into consideration the large population of our country. The number of licensed amateurs in India at present is slightly more than 500 and thus the ratio, as someone has earlier noted, would come to one amateur per 700,000 of population. I am told that the number of active amateurs i.e. those amateurs who have their own equipment and go on the air quite often is still smaller. While this small number gives the practising amateur in India a special position, it also indicates a rather unhappy situation about the spread of radio amateur activity in India.

Our thoughts therefore should turn to find out what is really standing in the way of this excellent technical hobby finding its rightful position in our technically minded youth. Is it due to the fact that this hobby is not within the means of our young people?

I understand that if a radio amateur is to be fairly active and has to obtain even a modest complement of radio equipment, it would cost him a few hundred rupees by the way of capital investment, assuming that he gets the communication receiver through disposal sources. In addition to the capital cost, the amateur enthusiast would be required to spend regularly for the electrical energy to run the station, spares, QSL cards, etc. Keeping in view the low level of incomes in India, it would appear that a large number of even middle class families would find it difficult to spare the requisite funds for this hobby.

One way of overcoming this difficulty and of popularising the hobby appears to be to have more radio amateur clubs in high schools and colleges and other institutions of technical education. This would bring the hobby within the reach of lower income groups and also give an impetus to our student community to become radio minded. The collective resources of such an amateur radio club would facilitate experimentation in new circuits and gadgets.

I do not know to what extent efforts have been made to spread this activity in schools, colleges and technical institutions. It seems to me that if efforts are directed to such institutions and clubs organised, there will be a faster spread of amateur radio activity. Having picked up interest while in colleges and institutions, the young men will perhaps like to continue the hobby individually after they have finished their studies.

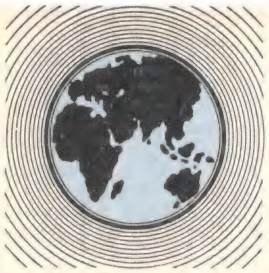
Cost of equipment, etc., will of course have to be brought down and it is here that the enterprising small scale industrialists can exercise their initiative and bring on the market cheaper outfits.

You may be aware that the Government of India have invited the International Telecommunication Union to hold the XIIth Plenary Assembly of the International Radio Consultative Committee at New Delhi from January 21 to February 11, 1970. This Assembly would be meeting for the first time in Asia and will be attended by about 350 delegates.

Experts in the field of radio communication from the leading countries of the world will attend this Assembly which will consider the recent trends in telecommunications such as colour television, satellite communication, television by satellites, new methods of radio navigation by ships, aircraft, etc. The delegates will include many amateur radio enthusiasts and it would be appropriate to take advantage of their presence to popularise this scientific hobby. I feel sure that the Indian amateur radio enthusiasts will be happy to meet in person their counterparts from abroad with whom they may have been in contact hitherto through radio communication.

Perhaps the organisers of this convention would like to avail themselves of this opportunity to have get-togethers with their counterparts from abroad at Delhi during the C.C.I.R. session. I may add that we are planning to organise an exhibition of radio equipment at the time of the C.C.I.R. Assembly in which co-operation of the members of this convention will be most useful. The exhibition, we hope will be visited by large numbers of technically minded persons whose interest in this fascinating hobby would be stimulated. I hope Indian amateur radio enthusiasts will display and demonstrate their equipment in the exhibition which will create interest in the student community as well as possible manufacturers of equipment.

(Continued on page 190)



LISTENING AROUND THE WORLD

Major program changes from Berne

The Swiss Broadcasting Corporation at Berne has made some major changes to its schedule, and has extended the Australasian Service from 90 minutes to 135 minutes.

by Arthur Cushen

The recent schedule changes of the Swiss Broadcasting Corporation has resulted in longer transmissions to various parts of the world. The service to Australia and New Zealand is now on the air from 0700 to 0915 GMT and is carried on three frequencies 9590, 11775 and 2150KHz. The program times and languages are as follows:

GMT	Language
0700-0730	English
0730-0800	German
0800-0830	French
0830-0845	Italian
0845-0915	English

The new program schedule shows that Swiss Short-wave Merry-Go-Round is now broadcast every second Saturday. Melody Train and Mailbag Show are also scheduled for the same day. The English transmission to the West Coast of North America is now heard from 0400 to 0430GMT, on 9535 and 11715KHz.

AFRICAN RECEPTION

During our winter months, signals from Africa on the 90M and 60M bands are received in two phases. Listeners in eastern Australia enjoy a long period of reception around dawn, while in New Zealand signals are heard for a long period in the late afternoons. Good reception in New Zealand in the early mornings of signals from Africa is possible from around 1600 to after 2000GMT, but in Australia, with the two-hour time difference, signals can be heard on these bands as late as 2200 GMT. The reverse applies in the late afternoon, when New Zealanders enjoy reception from Africa (also from South America) from around 0400GMT onwards, while in Australia reception would not be possible much before 0600GMT.

We have listed below some of the most interesting signals being heard. This is based on material from Bob Padula in Melbourne, with reports on morning reception in Australia; and observations from several New Zealand readers of signals heard in our late afternoons.

KHz

3232 Radio Brazzaville has been heard with a program in French at 2015 and followed to signoff at 2115GMT.

3260 Niamey heard at 2045GMT with a different program to that on 5020KHz. Both programs are in French.

3300 Bujumbura, new high powered transmitter now in use with a Swahili program at 2015, news in French at 2050 and signoff at 2100GMT.

3356 Radio Botswana heard with a native program at 2035GMT. The same program has been observed on 4845KHz.

3373 Lourenco Marques has an English service beginning with "Hour of Decision" at 2030GMT. Parallel with 4762KHz.

3375 Emisora Oficial, Angola, heard at 2035GMT with jazz music and Portuguese announcements.

3986 Lagos, Nigeria, heard with interval signal at 0600 followed by news in English.

4770 ELWA, Monrovia, heard at 0630 answering listeners' letters and dedicating music to the West African audience. Signoff at 0700GMT.

4813 Upper Volta with French commentary at 2125GMT.

4904 Chad, French program at 2120GMT, mixed with Peking.

4911 Zambia heard with vernacular program at 2055GMT and signoff at 2105 with anthem.

5012 Rhodesia, with Party Show on Saturdays 2120GMT, in English, parallel with 4828KHz.

5047 Lome, Togo, has popular music with French announcements at 2120GMT.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney 12 hours for Wellington.

SIGNALS FROM MALAYSIA

Signals from Malaysia are reported by Theo Donnelly formerly of Auckland, New Zealand, but now listening in Vancouver, Canada. His observations show that signals from Asia are very similar to those received in New Zealand, though reception time is a little later.

Radio Malaysia, Kuching, Sarawak, operating on 4835KHz has been observed with an interval signal of 1500 and then a news bulletin relayed from Kuala Lumpur. Another Kuching signal has been noted on 4950KHz with the English service at 1600GMT, and on occasions the station has been heard with transcribed programs from the Voice of America. Radio Malaysia, Kuala Lumpur, has been heard with the Indian Service on 4845KHz with identifications at 1400GMT.

CKFX VANCOUVER

The world's lowest powered short-wave station is undoubtedly CKFX, which operates on 6080KHz with 10 watts. We first heard this station in the late 1930s, but it had been on the air for some years before that, relaying the medium-wave station CKWX, which commenced operation in 1923.

An interesting report from Theo Donelly in Vancouver states that CKFX is still on the air, and in fact causes some interference to the reception of Radio New Zealand in the Vancouver area. The very low power used by CKFX has often caused listeners to wonder at the use of such a station, when its medium-wave transmitter of CKWX operates on 1130KHz with 50KW. This relay of medium-wave stations in the 49 metre band by broadcasters in Canada is not uncommon. Programs from staitons in Montreal, Calgary, Sydney, Toronto and Halifax are also carried on this band, while the C.B.C. in Vancouver and St. John's relay their medium-wave programs on short-wave.

RADIO LIBERTY, TAIWAN

Radio Liberty, P.O. Box 2160, Taipeh, Taiwan, verified reports by letter. This is the same organisation which operates stattions in Spain and Germany. The present schedule is carried on three frequencies, and transmissions are in the various dialects used in the U.S.S.R. The transmitters are leased from the Broadcasting Corporation of China on Taiwan.

GMT	KHz.
1000-1500	15125, 17720, 17780
2100-2400	15125, 17720
2200-0100	17780.

SOUTH AMERICAN RECEPTION

Listeners in New Zealand, and to a lesser degree in Eastern Australia, are now enjoying reception of South American signals in our afternoons in the 60 and 90M bands. Signal behaviour, at the time of going to press, suggests that this is going to be an excellent season as the South American stations are being heard not only on the low frequencies, but also on the broadcast band. A review of the best of the transmissions we have noted, in order of frequency, follows:

KHz

3378 HCDY4, Ecuador fair at 0600GMT with typical Latin American programs.

3995 HCJA5, fair signal at 0600.

4650 HCAK2, Ecuador, commercial program to sign off around 0700.

4680 HCWR1, Ecuador, all night with network programing.

4690 TIHBG Radio Reloj, Costa Rica, good at 0700, all night programs.

4807 HCMV5 Ecuador, heard with all night programs at 0700.

4945 HJDH Radio Colosal heard with all night program at 0600.

4965 HJAF, Radio Santa Fe, Colombia, another good all night signal.

4980 YVOC Ecos del Torbes, Venezuela, good signal at 0730.

4995 OAZ4'c radio Andina, Peru, heard to sign off 0780 with anthem.

5020 HJFW, Radio Manizales, Colombia, all night programs.

NEW INSTALLATIONS

In a recent issue of "Sweden Calling DXers" bulletin some details are given of power increases and new transmitters to be put into service shortly.

ALBANIA: China has delivered a considerable amount of broadcasting equipment to Albania. New short-wave transmitters may go on the air in a few months. Radio Tirana expects to greatly increase broadcasts to west and east Europe.

FRANCE: ORTF plans to install four short-wave transmitters of 300KW at Allousis. They can be linked together in order to increase the output to 600KW. Short-wave facilities are also planned for Guiana and New Caledonia, but work on these projects has not yet begun.

INDIA: All India Radio is now setting up two 100KW short-wave transmitters in Aligarh, Upper India, to cover Europe. The aerial tower was completed last year. Test broadcasts from these transmitters are expected any time from June this year and also from a 1000KW medium-wave transmitter at Rajokot. Another 1000KW medium-wave transmitter is planned, located at Leh, Kashmir, to cover Eastern Europe and parts of Western Europe, and will be completed by 1975.

MALTA: Radio Deutsche Welle with studios at Cologne West Germany, is to set up a relay base on Malta for services directed to Africa, mainly in the Arabic language.

PORTUGAL: A new commercial station, Radio Trans Europe, is expected to commence regular operation this month. The station is being constructed south of Lisbon, near the seaside resorts Sa Torpes and Sines. There will be three short-wave transmitters of 250KW each.

W.I.B.S. USING 21690KHz

Excellent signals have been received on 21690KHz from the Windward Island Broadcasting Service, operating from St. George, Grenada. Our reception has been to sign-off at 2130GMT. Transmissions at this time are directed to the British Isles. The W.I.B.S. Service to Britain is now on the air 1945-2130GMT on 21690KHz, and from 2135 to 2200GMT on 15110KHz.

The full transmission schedule to listeners in the Caribbean is as follows:

GMT	KHz
1545-1800	9550
1454-2245	5015
2155-0215	3280
1545-1800	15105
1845-2245	15105
2315-0215	11970

P.B.S. MANILA

A report in "Australian DX News," says that toward the end of 1969 the Philippines Broadcasting Service took over the short-wave transmitters at Malalos which were previously used by the Voice of America for relay purposes, and that further information has come to hand on the new schedule for these transmitters. The main change is that the P.B.S. is now using one of the 50KW units in the 31 metre band, and the low powered 7½KW unit is now used in the 49 metre band. The schedule is as follows:

GMT	KHz	KW
2100-1500	6170	7.5
0300-0400	9580	50
0900-1400	9580	50
2100-2300	11950	50
0300-0400	11950	50
0900-1400	11950	50

KGEI RETURNS TO 15440KHz

Radio KGEI in San Francisco has returned to 15440KHz for all its transmissions for our winter period. The station is on the air from 2230 to 0500GMT with Portuguese. Spanish and English programs have been observed from 0430GMT.

Short-wave facilities are located in Belmont, California for the purpose of broadcasting to Mexico, and Central and South America. Programs are in Spanish, Portuguese and English. The geographical location of KGEI permits coverage of the target area with a single transmitter. The present 50KW transmitter is soon to be replaced by one of 250KW, which is expected to arrive in Belmont about now, but the considerable task of installation and testing, which may take some months, is still to be carried out.

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Dwell Meter . . . . Four direct reading scales:
8 CYL—0.45 degrees.
6 CYL—0.60 degrees.
4 CYL—0.90 degrees.
3 CYL—0.120 degrees.

Tachometer . . . . Two Ranges:
Low RPM: 0-1500
High RPM: 0-4500

Voltometer	Direct reading scale, 0-15 volts DC.
Power Requirements	Approximate average current, 10mA.
Meter	4½", 1 mA, 100 degree movement.
Accuracy	± 3% of full scale.
Dimensions	8½" wide x 4¼" high x 7¼" deep (including handle).
Net Weight	2½ lb.

For complete information contact:

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RADIO RABAUL

According to a report in Radio Australia's DX Session, Radio Rabaul is now being shared between the Department of Information and the A.B.C. This transmitter is used by the A.B.C. on 5985KHz with the callsign VH9RA from 2230-0530 GMT, when it carries the programs of the A.B.C. medium-wave station 9RB. The Department of Information uses it between 2000-2200GMT and 0600-1300GMT, with the callsign VL9BR, which operates on 3385KHz.

DZH4 USING 1KW

Information to hand on DZH4 Manilla, reported in a recent issue as using the low frequency of 2425KHz, gives its power as 1KW. The station, operated by the Radio Mindanao Network, has been on the air since June 1969. It was first noted at our listening post around November and subsequent improvement in signal level enabled it to be identified.

The reception has always been fair in recent weeks. The station relays DZHP, and has news at 1130GMT. The transmitter on 2425KHz is now supplemented by another transmitter, also of 1KW, on 7260KHz. Both stations are on the air 24 hours a day with the relays of DZHP. This is the first time the Philippines has used the 120M band for its short-wave relays of medium-wave programs, so the reception of DZH4 is all the more interesting.

RADIO NEW ZEALAND

Transmissions from Radio New Zealand in Wellington are beamed to the Pacific and Australia, and the following schedule is in effect until September 5.

To the Pacific

GMT	KHz
1700-1945	6080, 9540
2000 2230	15110
2245-0545	15280
0600-0845	6080, 9755

To Australia

2000-0545	17770
0900-1145	11830, 9520

To Antarctic (Sundays only)

0815-0845	9520

LISTENING IN THE THIRTIES

One of our readers, Mr Edwin Francis, of Springwood, N.S.W., recalls some of his early listening experiences in India in the late 1920s and early 1930s. As a Salvation Army missionary, he left England in 1925 to go to southern India for hospital and leper work. He remained there until 1937 when he migrated to Australia. In 1933, while on leave, he visited England, Canada and the U.S.A. where he compared the radio reception with the ear phones of the early twenties.

A friened offered to buy him a short-wave receiver to take back to India as the leper hospital was an isolated place on the edge of the jungle. He contacted several large radio firms, including the Marconi Company, but they were unable to supply him with a short-wave receiver to operate from batteries and withstand the humidity. Later one of his friends made up a set which he transported to India in pieces.

On short-wave, the main stations were the B.B.C. and Radio Nederland (and Edward Startz) with a few other ones. On medium wave, there was very little other than Madras and Colombo. It was a thrill to hear Sydney, and later receive a verification card.

Listening was always a battle as failures occurred due to the moisture in spite of a lamp kept alight to counter this. Also, he had to contend with the old plug-in coils. The radio was run off the dynamo as the only source of power. It was all great fun and gave Mr Francis a lot of enjoyment. He felt he was not cut off from the world so much. Before leaving India, Mr Francis sold the bits as junk for a few rupees. When he arrived in Sydney, he discovered the marvels of modern radio in 1937.

NEW SCHEDULES OPERATING

RADIO NORWAY

The present schedule of Radio Norway broadcasting from Oslo is in effect to September 5. Broadcasts are in Norwegian except on Sunday when the last 30 minutes of each transmission is in English. The two transmissions to North America carry English on Monday.

GMT	KHz	Area
0700-0830	15175, 21655, 21730, 25730	Australia, New Zealand
1100-1230	7120, 17825, 21655, 21730, 25730	West Australia
1300-1430	17825, 21655, 21730, 25730, 25900	India, Pakistan
1500-1630	17825, 21655, 21670, 21730, 25730	West and South Africa
1700-1830	7210, 21655, 21730, 25730, 25900	North and Central Africa
1900-2030	15175, 21655, 21670, 21730 25730	Europe
2100-2230	15175 17795, 21655, 21730, 25730	North America
0100-0230	11735, 11850, 11860	Central America
0300-0430	11735, 11850, 11860	North America

BROADCASTS FROM PYONGYANG

The present schedule of Radio Pyongyang, North Korea is as follows:

GMT	KHz	Language
1900-2000	6540, 9615	English
0200-0300	6540, 15520	English
0800-0900	6540, 15520	English
1100-1200	9615	English
1400-1500	9615, 11765	English
1500-1600	9615, 11765	French
1700-1800	6540, 9615	French
2100-2200	6540, 9615	French
0100-0200	11765, 16320	Spanish
2300-2400	11765, 16320	Spanish
1600-1700	6540, 9615	Russian
0900-1000	9615, 11765	Russian
2200-2300	11765, 9615	Chinese
1000-1100	11765, 9615	Chinese
1200-1300	11765, 6540	Chinese
0300-0400	6540, 15520, 635	Japanese
0900-1500	6540, 635	Japanese
2000-2100	6540, 9615	Korean
2400-0100	11765, 16320	Korean
0400-0500	6540, 15520	Korean

ENGLISH FROM ROME

The present schedule of the Italian Radio, Rome is a follows:

GMT	KHz	Area
0100-0120	9575, 6010	North America
2200-2225	11905, 9710, 5990	Japan, Australia
0350-0410	11905, 9710, 9630	South Asia
1935-1955	9710, 7275, 6050	Great Britain
2025-2045	9710, 9575, 6050	Near East

NEW GOSPEL STATIONS

According to an item in the Melbourne "Herald" and forwarded by Bob Padula, plans have been formulated for a new Church organisation, with all major Churches represented, which wants the Australian Government to permit religious radio stations in Papua and New Guinea. The Christian Communications Commission meeting in Lae decided to ask members of the Territory's House of Assembly to press the Australian Government for this. A spokesman said existing radio services did not adequately meet the spiritual needs of the community. Only the Australian Broadcasting Commission and the Administration are allowed to operate radio stations.

BRAZILIAN RECEPTION

Reception of signals from Brazil in the 25 and 19M band is covered in a survey from Bob Padula, Melbourne. The reception period is mainly around 0800 onwards, and again in early afternoons to around 0300GMT.

KHz

11720 Radio Nacional Brasilia mixed with Peking from 0830 to 0925GMT.

11765 Radiodifusao de Sao Paulo is heard in the period 0830 to 0900 when it is blocked by Moscow and Pyongyang which open at this time.

11785 Radio Guiaba, Porto Alegre, heard after Baghdad signs off at around 2300 and can be received up to 0200.

11795 Radio Nacional Rio de Janeiro heard after Deutsche Welle closes at 0900, but is blocked by the same station again at 0930.

11805 Radio Globo, Rio de Janeiro heard after 2300 when WNYW leaves the frequency.

11925 Radio Banderaintes, Sao Paulo good from 0230 to signoff at 0300.

15105 Radio Rural Brasiliera has been heard around 0900 and again to sign off at 2330.

15155 Radiodifusao de Sao Paulo heard as early as 2000 to around 0300, but at times is mixed with Havana.

15225 Radio Cultura da Bahia, Curitiba noted between 0830 and 1000.

15370 Radio Tupi, Rio de Janeiro heard as early as 2230 to signoff at 0300.

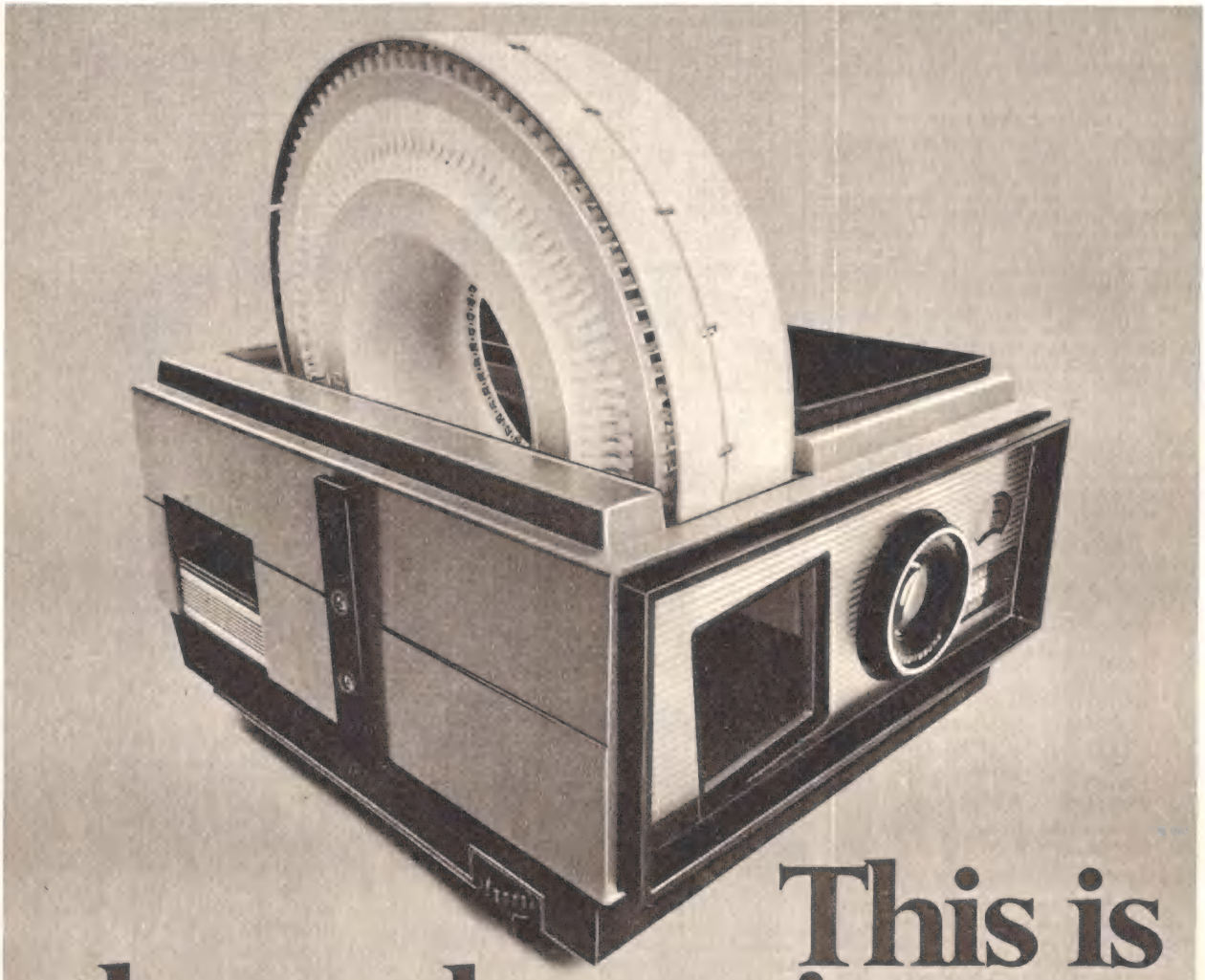
15415 Radio Clube de Riberiarao Preto heard around 2230 with typical commercial programs, but suffers interference from Madrid using 15420Khz.

15445 Radio Nacional, Brasilia heard between 0900 and 1000 when there is no jamming on the channel.

HCJB VERIFICATIONS

According to announcements from HCJB in Quito, Ecuador, some restriction on verifications issued by the station recently came into force. This is in line with other broadcasters who require much more detail before they will confirm reception. During 1970 the station will offer four verification cards, one for each quarter of the year. These will only be issued if reports meet the following requirements:

1. Date of reception.
2. Time of reception in GMT.
3. Frequency, accurate to within 5KHz — the metre band only will not be acceptable.



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Do you fiddle with exposure, fuss over focus and then ruin all your results with fuzzy projection? It's not right! Your slides need a Paximat. Paximat needle sharpness is what they deserve. Only Paximat top quality optics will do justice to your slides.

Paximat 5000 & 3000 model projectors have Autofocus. A measuring beam adjusts the sharpness electronically. All you do is . . . insert the magazine, focus the first slide, set the interval timer (18, 15 or 30 secs.) and sit back. Also changes slides manually and by remote control.

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Select a Paximat projector from $62.50.
5 models to choose from: Pico S, 1000, 1800, 2000, 3000, 5000.

See your camera store, department store, or chemist. Ask about the Paximat range of slide projectors.

Brochures from **Photimport Pty. Ltd.** Melbourne, Sydney, Brisbane, Adelaide, Perth.

FP223

4. Name of program.
5. Items that identify the program.

In order to receive an airmail reply, three International Reply Coupons should be enclosed with each report. If no postage is enclosed, the verification will be sent by seamail.

RADIO SAN REMO

According to a report in the European DX Council Bulletin, Radio San Remo could again become operational. A proposal has been made in the Italian Parliament to resume commercial broadcasting from the long-defunct Radio San Remo, in order to stem the flow of advertising money out of Italy. The action has been prompted by the growing success of Radio Monte Carlo, which is now beaming 12 hours of pop music to Italy every day. Radio San Remo was originally set up in the 1930s. Backers of the plan to resurrect Radio San Remo say it could quickly become operative again after technical modifications and the hiring of staff.

JAPAN MAKES CHANGES

Recently Radio Japan expanded its overseas service from 36 to 37 hours per day, revised some of its transmission times, and expanded the time given to the Bengali and Urdu services. Tokyo now carries broadcasts in 23 languages directed to listeners in all continents of the world. The transmission from Radio Japan to Australia and New Zealand is very well received on two frequencies, 11875 and 15235 KHz on the air 0939-1030GMT.

WORLD RADIO CLUB AWARD

For nearly half a century listeners have been reporting to broadcasters on transmission reception. In return, the B.B.C. and other broadcasters have sent cards to verify correct reporting.

Now, in addition, B.B.C. External Services offers an award to listeners who correctly report on a number of B.B.C. transmissions received from different transmitting sites. The reports will be analysed by the engineering staff and certificates issued by the World Radio Club. This award scheme applies to part of one frequency schedule period only, from May 3 to June 30, 1970.

To qualify for the award, listeners must give evidence of reception of three B.B.C. transmissions from each of the following:

Great Britain and the Atlantic, East Mediterranean and Far Eastern relay stations.

These 12 reports, which must be received in one envelope before the end of July, should contain the following information: Location, date, time, frequency and a few words about program content. In return, the award will contain the four verifications required by the serious DXer.

To be eligible for the award, a DXer must be a member of World Radio Club, the program for Dxers and short-wave enthusiasts, which is broadcast in B.B.C. World Service on Sundays at 0815GMT, Thursdays 1245GMT, Fridays 2345GMT, and on the North American Service on Mondays at 1515GMT. To become a member, write to World Radio Club, B.B.C., Bush House, London, W.C.2.

FLASHES FROM EVERYWHERE

EUROPE

POLAND: Radio Warsaw in Poland has been heard with programs in English to North America on several frequencies. Mike Highley, of Wellington, N.Z., reports reception on 11870KHz with a program from 0315-0345GMT. Other frequencies are reported by John Corder, of Timaru, N.Z., who heard this transmission on 11815 and 15275KHz.

GERMANY (EAST): Radio Berlin International provides good reception on 21465KHz with English from 0645GMT. Another frequency, 9500KHz, has been heard closing at 0700GMT with details of the transmissions beamed to Africa.

BELGIUM: Bryan Clark, of Wellington, N.Z., has heard Brussels on the new frequency of 15435KHz with the program "Belgium Speaking" at 2305GMT. The transmission has also been observed at this time by other readers who report some interference from Cologne on the same frequency. Brussels is also using this channel from 2330-0100GMT beamed to North America in French and Flemish. The same program is transmitted on 6125KHz.

AFRICA

LIBERIA: Two signals from Liberia were reported by Cyril Anderson, of Perth, W.A., in a recent broadcast over Radio Australia. The Voice of America relay station at Monrovia was heard on 3990KHz at 2300GMT, with the English program "The Breakfast Show." ELBC on 3255KHz was heard with popular music at 2230GMT and news at 2245GMT. An airmail verification from ELBC was received in 24 days in the form of a blue and white QSL card bearing the slogan "The Sound of Progress."

EGYPT: Radio Cairo has a new frequency for transmissions to Europe, put into service after several tests had been made. The new frequency is 9675KHz which replaces 9740KHz. English is broadcast at 2145GMT, while other languages used are Italian at 1830, French at 1930, and German at 2030GMT.

TOGO: According to a recent verification from Radiodiffusion, Togo now runs the following schedule: on 6155KHz, 0500-0900, 1200-1400, 1630-2300GMT; on 5047KHz, 0530-0800, 1730-2300GMT; on 7625KHz, 0800-0900, 1200-1400, 1630-1730GMT. On Saturdays, the schedule includes 1400-1630, and on Sundays broadcasts are on the air uninterrupted 0530-2300GMT.

IVORY COAST: According to a report in Contact, the Ivory Coast radio has been heard on 11920KHz with an English news bulletin at 1830GMT. The station has further been reported with a news bulletin in French at 2030GMT.

TANZANIA: The International service at Radio Tanzania, Dar-es-Salaam, operates on 15435KHz from 1700-2000GMT. News is broadcast in English at 1700 and 1800GMT.

BURUNDI: According to a report from the European DX Council Bulletin, Radio La Voix de la Revolution, Bujumbura, now signs on 30 minutes earlier at 0330GMT on 6140KHz. The announcements are given only in vernacular.

CONGO: Radio Kinshasa has dropped 11720 and 11795KHz and now broadcasts continuously 0400-0300GMT on 4880, 7115, 9775 and 15245KHz. Radio Lubumbashi's foreign service is on the air 1400-2100 on 11865KHz. The program is broadcast irregularly and has been heard at times with a relay of the home program signing off at 2200GMT.

ASIA

PHILIPPINES: Sam Dellit, of Brisbane, has observed Radio Veritas, the Catholic missionary station at Manila, on 17885KHz during a special test transmission to India. The station was noted with excellent signals between 1530 and 1600GMT, with announcements in an Indian language and English. The station requested reports and announced the mailing address as P.O. Box 123, Manila, Philippines.

BRUNEI: Radio Brunei has been observed in Ceylon on 6130KHz. Reception has been noted at 1315GMT with English. The station closes down at 1430GMT.

BROADCAST BAND NEWS

NEW CALEDONIA: The O.R.T.F. station at Noumea has recently opened a new high power medium-wave transmitter on 670KHz. This new station carries the same program as heard on short-wave on 3355 and 7170KHz. Reception in New Zealand on 670KHz has been from 1900GMT with their morning program, and again from 0600 to signoff at 1100GMT. Towards the end of the transmission there is some interference from the A.B.C. station 2CO on the same frequency. In the past, Radio Noumea has broadcast on 1420KHz with 4KW of power.

QATAR: Radio Qatar at Doha is reported in the Australian DX News as being received on 674KHz. The station has been hard from around 1630 in Arabic, and at 1900GMT with a program of western type music. The station signoff has been observed at 1930GMT.

TRUCIAL STATES: Radio Abu Dhabi is listed in a recent issue of the bulletin of the European DX Council as a new station. The station is on the air daily with 50KW on 809KHz. The full schedule is 0230-0510 and 1230-1850-GMT, with all transmissions in Arabic. The address of the station is P.O. Box 17, Abu Dhabi. The Chief Engineer is Mr C. I. Kennedy.

GUITAR AMPLIFIERS

10-Watt, Two-Channel, with Twin Cone Speaker $53.55
14-Watt, 4 Inputs. Base and Treble Boost, 2 Twin-cone Speakers, $63
17-Watt, 4-Channel, Bass and Treble Boost. Two Twin-cone Speakers $76.25

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin-cone Speakers. $109.05
Vibrato with foot control and 2 preset controls for frequency and intensity, $10.50 extra on above models.

REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.
$5.75
Post 35c.

G.D.O. UNITS

Post: N.S.W. 50c, I'state 75c.
T.E. 15 Transistorised, 7 Band, 360 Kc to 270 Megs.
$39.75

MULLARD MAGNAVOX

Designed bookshelf enclosure with 6WR twin cone and 3TC tweeter $24.75 ea.
Super bookshelf enclosure with 2 x 6 WR .. .. .. $36.75 ea.
Hi-Fi enclosures with magnavox 8WR or Rola C8MX . . . 8 watts RMS .. .. $36.75 ea.
With 2 x 8WR or 2 x 8CMX 15 Watts .. .. $45.00 ea.
With 10WR — 10 Watts $39.75 ea.
With 12WR — 10 Watts $45.00 ea.
With MSP 12 UAX — 20 Watts .. .. $55.00 ea.
8 or 15 ohms available.
All cabinets are constructed of Pineboard and Veneered with Oiled Teak Formica and are complete with crossover network — Tweeter — Innerbond packing.

PLAYMASTER 127 STEREO CONTROL UNIT

For tape replay, Magnetic, disc, and crystal cartridge input. Radio fully described Nov. 69 issue E.A.

KIT SET $49.50
Wired and Tested $59.50.
Pack and Post 75c.

128 STEREO AMPLIFIER

64 Watts per channel
Kit Set $95.00
Wired and Tested $109.00

PIGGY BACK GUITAR AMPLIFIER

30 Watt $79.75
45 Watt $89.75
60 Watt $119.75
4 Inputs, Bass and Treble Boost Vibrato if required, $10.50 extra.

PIGGY BACK GUITAR AMPLIFIER

Complete with Speakers & Cabinet
30 Watt Lead $138.75
30 Watt Bass $146.75
45 Watt Lead $158.75
45 Watt Bass $166.75
50 Watt Lead $218.00
60 Watt Bass $234.00
Vibrato if required extra $10.50

50 WATT SOLID STATE GUITAR AMPLIFIER

E.A. July & August Issue.
Kitset, inciuding Cabinet.
$98.00
Wired and Tested.
$114.00
Speaker Enclosures to suit 4 M.S.P. Speakers.
$104.00
2 Pioneer 15in Speakers.
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2 Rola 50 watt Speakers.
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NEW COMMUNICATIONS RECIEVER

Kit-Set $190.00
Wired and Tested $230.00
Pre-wound coils are available separately.

ALL SILICON TRANSISTOR SOLID STATE STEREO AMPLIFIER

240V AC powered, 8 watts RMS per channel inputs for magnetic, ceramic, and crystal cartridge, also recorder and radio tuner. Hi-Fi frequency response speaker matching 4-16 ohms. Size 10½in x 6½in x 3½in. Attractive oiled teak cabinet.
$54.00 Pack and Post $1.50.

STEREO RECORD CHANGER

Current models, 4 speeds, automatic or manual operation.
Standard model $28.50
Ceramic cartridge. Sapphire Stylus, Standard model with 12in turntable $34.00
Deluxe model with 12in turntable. Cueing device. Ceramic cartridge. Diamond Stylus $40.00
Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added $46.50
Deluxe model as above with 12in Diecast Heavyweight Turntable, 4-pole Shielded motor. Suitable for Magnetic cartridge $56.50

PLATFORMS

Teak Platforms, suit above changers, $9.00. Fully moulded tinted perspex covers, suit platforms 17¼in x 13½ in x 4in, $9.00.
Pack and Post, 50c.

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240VAL. Especially designed for fringe area reception. Also up to 3 TV sets can be operated off common aerial for improved signal strength.
$15.95 Post Free.

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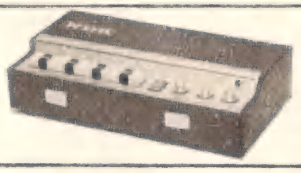
VERTICAL AXIS
Deflection Sensitivity (at 1 kc) 0.1 V p-p/cm.
Frequency Characteristics, 1.5 cps —1.5 MC.
Input Impedance, 2 M ohms 25pF.
Calibration Voltage IV p-p/cm.

HORIZONTAL AXIS
Deflection Sensitivity 0.9V p.p./cm.
Frequency Characteristics 1.5 cps —800 KC.
Input Impedance 2 M ohms 20 pF.
Sweet Oscillator (5 Range) 10 cps —300 KC.
Synchronisation Devices Internal (Positive and Negative. External).
Power 240v AC 50/60 cps.
Cathode Ray Tube 3KFIF.

3-inch $102.75

5 Meg Bandwidth Push-Pull vertical and Horizontal Amplifiers, 8 positions, high sensitivity, vertical Amplifier Frequency Compensated on all positions. Calobrated .02 to 600 volts. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

5-inch $118.75



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12 RHYTHMS.
9 PERCUSSIVE INSTRUMENTS
240v A.C. OPERATION.
$145.00

AUDIO GENERATOR

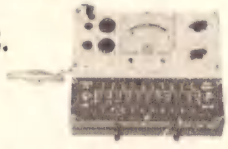
De Luxe Model TE—22D.
Freq. range, Sine 20 cps—200 KC. SQ. 20 cps—25 KC. Output Voltage, Sine 7V, SQ, TV P.-P. Output Impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation. 1/1, 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.
$42.95

LEADER SIGNAL GENERATOR LSG11

240 V AC operated, 6-band 120 KC to 390 Megs. Provision for crystal.
Post N.S.W., 75c; Interstate $1.25.
$39.50

MODEL TE-65 V.T.V.M.

DC, V 0-1.5-5-15-50-150-500-1,500 V. Rms, A.C.V.0-1.5, 5.5-15-50-150-500-1,500 V. Rms, 0-1.4-4-14-400-1400-1400-4000 V. P.P. Resistance: RX10, 100.1K .10K, .100K, 1M 10M, Decibel — 100dB minus-plus 65db.
240 V.A.C.
$43.75
TECH. P.V.58, $40.50.



T.C. 2 VALVE TESTER

Tests all valves, diodes, rectifiers, checking filaments, shorts. Merit on direct reading. Good-bad meter. Complete with tube chart.
$28.75
Pack and Post. $1.25.

T.V. RIBBON

300 ohm 9c per yd.
$7.75 per 100yds.

B.S.R. 4 TRACK

3 Speed Stereo Tape Deck.
$41.50

MUSICOLOUR

Sound control of coloured lights. As described E.A. Oct., 69.
Kit Set $46.05
Wired and Tested $54.00

SIGNAL GENERATOR

De Luxe Model TE20D.
Freq. Range 120 KC—500 Mcs. 7 Bands. Accuracy 2 per cent. Output 8V. Provision for Xtal. Suitable for self-calibration Marker generator. Printed circuit. 240 T.E.20. $25.50.
V.A.C. .. ..

HIGH POWER LOW FREQUENCY SPEAKERS

Suit Bass and Organ
15in imported, 30 watts RMS $30.00
15in Local 25 watts RMS $47.50
12in Rola 50 Watts RMS $46.50
12in Rola Twin Cone 50 watts RMS $52.50

NEW LOOK SPEAKER ENCLOSURES

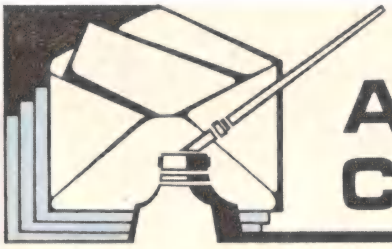
Hi-Fi Freq. response. Power rating 5 watts R.M.S. Attractive, modern, oiled teak finish. Size 14½in x 4¾in x 9.
$15.00 EACH
Post 75c. Interstate $1.25.

T.E. 46 RESISTANCE-CAPACITANCE

Bridge and Analyser.
Capacity 20pf to 2000mfd.
Resistance 2 ohms to 200 megs.
Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs, at 600V.
Indications by eye and meter.
$53.75

VOLT A.C.

VARIABLE TRANSFORMER.
0-260V, 10 amp $49.50
0-260V, 5 amp $37.50
0-260V, 2½ amp $25.50



ANSWERS TO CORRESPONDENTS

PARTS FOR STEREO AMPLIFIER: I am building the 10-plus-10 stereo amplifier described in your April, 1969, issue, and have been unable to obtain the printed wiring board 68/a8, the type MB1 bridge rectifier, and the B8-320-01A/10E or E215AB/15E thermistors. Can you tell me where these components can be obtained, or if there are suitable substitutes? **(J.K., Seven Hills, N.S.W.)**

● A cursory glance through the March issue of the magazine revealed a number of advertisers offering to supply complete kits or separate components for all "Electronics Australia" projects, and in some advertisements the actual components you mention are offered. We suggest you examine the advertisements to decide which supplier you will find most convenient to use. (We particularly urge readers to examine the advertisements before writing to us to complain that parts are not available. Several advertisers specialise in supplying parts for our projects.)

SEPARATE METERS. I am a young amateur electronics enthusiast with hopes of becoming a licensed amateur one day. I want to build a moderately sensitive voltmeter and an ammeter — both completely separate units, so that voltages and currents can be measured simultaneously. The ranges should be fairly comprehensive and the units should not be very expensive. Can you supply circuits for the above, and can you tell me where I could obtain inexpensive 0.5mA meters? **(M.W., Park Orchards, Victoria.)**

● In view of the overwhelming preference for multimeter type instruments, we have featured only this type of instrument in our projects. However, there is no reason why you should not construct the sections of such an instrument separately. In fact, the flush of inexpensive imported multimeters on the market has encouraged people to use a number of multimeters, not a number of single-purpose instruments. It is against our policy to recommend individual suppliers of parts. We can only suggest you watch the advertisements in the magazine for a suitable meter movement, or write to some of the suppliers of components who advertise regularly.

COUPLING CAPACITOR VALUE: On what basis does one determine the value of the coupling capacitor in an R-C coupled amplifier? I have not found the answer to this problem in the textbooks which I have available for reference. Also please find my remittance for previous query which you answered by mail. **(L.P.S., Herston, Qld.)**

● Your question is strictly outside the scope of the Information Service, L.P.S., but very briefly the answer is that the coupling capacitor and the effective load resistance formed by the grid or base bias resistor(s) forms a high-pass or "bass cut" filter. Hence the response will be 3dB down at that frequency where the reactance of the capacitor is equal to the load resistance, so that one chooses the value of the capacitor to set this frequency below the range in which operation is required. We hope this very brief explanation is of assistance and thank you for your remittance for the previous answer.

SLEEP TEACHING: I have recently purchased a hi-fi stereo system, and am interested in doing experiments with "Sleep Teaching," pre-recorded information being played back by tape recorder and absorbed by the subconscious mind while sleeping. However, I require a timing device which I could insert between the power point and the amplifier, allowing the unit to be switched on and off at any required time. Have you information on how I could obtain such a unit and the approximate price? **(V.F., Coburg, Vic.)**

● In the December, 1955, issue we described a switching clock, using a commercial unit of a general type, which is, we believe, still available from disposals stores. Photostat copies of this article can be supplied at 20c per page (3 pages). A clock system is generally easier to arrange than an electronic system.

ANALOG COMPUTING: Have you published a circuit for a high gain amplifier, relatively inexpensive to build for use in analog computing? What is the possibility of a series of articles dealing with analog computing? I am building the 1953 Little Jim and hope to pick up European stations. Could you recommend an aerial for use with this set and would one mounted in the roof work satisfactorily? **(S.W., Clovelly Park, S.A.)**

● While we have not published any amplifier designs specifically with analog applications in mind, no doubt many circuits could be adapted to perform this function. However, as most computer requirements are fairly specialised it would not be possible to make a recommendation without knowing the particular application you have in mind. We have no immediate plans to run a series in the magazine on analog computing. While there can be no real substitute for a high-slung, resonant aerial system, usually some compromise has to be made, particularly if space is the limiting factor. The design of a general purpose SW aerial is available through our Information Service under File No. 2/AE/13. A shortened version would most likely fit under a tile roof although the results may be far from optimum. An aerial favouring a particular frequency may be an advantage and the length in feet may be found by dividing the frequency in MHz into 468. Make sure the aerial, when installed, is at right angles to any noise source such a high voltage power lines.

YOUNG READER: I bought my first copy of Electronics Australia in 1965, and since then have noticed a terrific improvement over this short time I have been a reader. I especially enjoyed reading the article on "The History of the Talkies," and wonder if you could do a similar article on the history of recording. I would like to know why vertical cut recordings were not produced for the commercial market. The advantages I can see are that variable pitch cutting is not required, and because of this, playing time is increased. I will leave the contents of my letter to perhaps stimulate thoughts for an interesting article along these lines. Just to prove that it isn't "old fogies" wanting nostalgia from collecting old records, I am 15 years of age. **C.L., Hawthorn East, Vic.**

● Many thanks for the kind words you expressed about the magazine, C.L. We are glad that you enjoyed the article on

"ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: For a 20c fee, we will supply data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for project data will be answered more speedily if the projects are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to six months old the cost is the face value, plus 5c surcharge. From seven to 12 months, 10c surcharge; over 12 months, 20c surcharge. Package and postage is 10c extra per issue. Please indicate whether a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W. 2001: 5/69

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Clnevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

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CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each

Post 10 cents.

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Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

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240 volt A.C. Input.

Each battery Charger will charge either 6 or 12 volt batteries.

2 amp. without meter, **$13.75**

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(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones $45, 60c cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike $60. 60c cartage to rail. Freight payable at nearest attended Railway Station.

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A.W.A. AUSTRALPHONE

Transceivers 12 V

New Complete Station.

1.6 to 10 megs on transmit.

0.54 to 16 megs on receive.

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10-100 Megs. LA5. $250.00.

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P.M.G. TYPE KEY SWITCHES. 45c each. Post, 15c.

BC 221

Frequency Metres

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BRAND NEW

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Special discount for quantity

807	75c	X61M	$2.20
6SN7GT	95c	CV850	$1.50
8989	$1.00	1H6G	30c
5U4G	95c	832	$5.00
EF50	35c	6AK5	$1.50
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6C4	80c	VR65	25c
2 x 2	75c	VT4C	75c
6AG5	80c	AU5	$1.00
12AU7	$1.00	80	$1.25
		6AK5W	$1.00

CATHODE RAY TUBES

3FP7	$2.95	5BP1	$3.50
3JP1	$2.95		
V1669 4/1	$2.95	CY2184	$2.95

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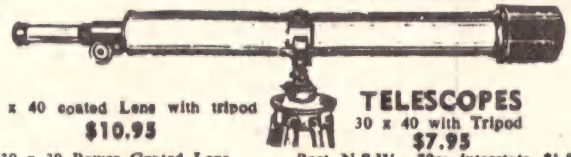

45 x 40 coated Lens with tripod

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30 x 30 Power Coated Lens Brand new.

$3.75

60 magnification with a 60mm coated objective lens. With tripod.

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As illustrated.

Postage, 95c; Interstate $1.20.

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BRAND NEW EX-ARMY

300 watt, 15 volts, 20 amps. Made in Canada. Complete with tools, instruction book, spares, etc. Only **$75.00**

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I.R.C. brand new, usually 80c ea. 50 assorted values for only

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Post 15c.

STEREO headphones, brand new, $7.50, post N.S.W. 60c. Interstate 85c.

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21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile) $7 per coil.

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Gramo Motors, New. Made in U.S.A. 4-speed 240 volt A.C. 50 cyc. Only $2.75 each.

Post, N.S.W. 30c; Interstate, 40c.

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70 ohms 4 positions, can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9in x 8in x 8in $5.00 each. Post N.S.W 70c. Interstate $1.20.

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(Austronic) 0-100 K/cs. 240V operated. $150.00

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Kleinschmidt 5 Unit Punch Reader and Tape Printer with Key Board. $95.00.

Cintel Oscillator and Electronic Counter, type 388. $250.00.

SELSYN MOTORS MAGSLIP Mk. II .. .. $5.25 ea.

No. 19 TWO-WAY RADIOS

Sold as is without power supply, leads, accessories, etc. Only $15. Or complete with above gear, $35.

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PRISMATIC. Coated Lenses Brand new. Complete with case.

8 x 30	$18.75
7 x 50	$22.15
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12 x 5	$23.95
20 x 50	$26.50

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3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

A.W.A. AMPLIFIERS

240 VAC with pick up Terminal. Used in good order Ex Studio.

5-watt model. **$15.00**

A.W.A. Mod. Osc. 150Kc-30 M/cs. $25.00.

522 TEST SET

100-155 M/cs. I.F. Generator, crystal locked R.F. Power Meter, A.C. Supply Meter. $25.00.

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.00. We haven't got time to sort them, so you reap the benefit. Post 60c.

MINE DETECTORS

Ex A.M.F with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station.

$39.00

4 DIGIT RELAY COUNTERS

50-volt D.C., suit slot car. Lap counters, etc.

$1.25 each. Post 13c.

ALTEC STUDIO MICROPHONES

639B Western Electric, top grade, original cost $250, ideal Broadcast Studio, music recording, Church and play recording, etc. Fraction of original cost.

Price on Application.

240 VOLT 522 POWER SUPPLY

Supplies all necessary voltages to operate 522 transceiver from 240 V A.C. Complete and ready to plug in $30.00.

SOLENOIDS

Plunger Type 12V 300M.A. Suit electric camera control, miniature trains, radio, etc.

$1.25. Post, 10c.

200 Mill. amp., 24 volt, 1/8in push movement.

$1.25. Post 10c.

CONDENSER LENS

2½in DIAM. 2in FL. $1.50 each or $2.50 per pair. Post 21c.

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1½in diam. 1½FL. 50c each.

Postage, 17c.

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With 4in Vu, meter GLORAD. Complete with Portable Power Converter. 600 ohm balanced input and output. Ideal for outside broadcasting, etc.

$39.50

TEN CHANNELS VHF TRANSCEIVER

Types TR1934 100-125 meg/cys. and TR1935 125-150 meg/cycles. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.

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TOP QUALITY BRAND NEW

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3" x 150' ..	65c ..	9c
5" x 600' ..	$1.35 ..	13c
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CASSETTE TAPES

C60 $1.60. C90 $2.20. C120 $2.99.

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Rack Mounting Tape Recorder, ex A.B.C. 7½-15 I.P.S. Full track tested. $150.00.

Microphone, Professional S.T.C. type 4017. $20.00.

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Marconi H.F. Sig. Gen. 85 K/cs. to 25 M/cs.. $65.00.

Pye 4 Channel Crystal Locked Oscillator. 1.5-30 M/cs. New. $25.00.

TRANSPONDER APX6

with Lighthouse Tubes. Can be converted to 1200 M/cs. $17.50.

WHEATSTONE BRIDGE

Top grade

In Multiples up to 1000

$65.00

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SORRY, NO C.O.D.

ANSWERS—continued

the "History of the Talkies," and the suggestion of a similar article dealing with disc recording has been passed on to the Editor for a possible article in the future. "Electronics Australia" (then "Radio and Hobbies") published a series of articles as early as 1943 dealing with disc recording, commencing with the June issue. Since then, the fidelity and technique of mastering and processing records has increased remarkably, culminating in the modern stereo disc of today. The reasons for and against vertical recordings are many, and these can be found in many good books on the subject in your public library. Early experiments with stereo recordings were performed on a vertical and horizontal basis, but it was difficult to accomplish equal characteristics in each channel. Thus we have the modern 45 deg./45 deg. system with which we are all familiar, and which gives balanced results from the respective tracks.

THANKS: I am writing to you to thank you for your fine magazine which I enjoy reading. I can also say that I have learnt quite a lot from your magazine about electronics. I also would like to thank one of your advertisers for the swift, accurate and friendly service he gave on one of my orders. I wish your magazine and the advertiser all the success for the future. **(D.D., Westernport, Vic.)**

● Thank you for the kind words of satisfaction expressed, D.D., and also for those comments you have made about the a vertiser. We have passed a photostat copy of your letter on to the advertiser on your behalf.

TELEVISION RECEIVER: I have been a regular reader of your magazine since 1947 and commend you for the consistently high standard you maintain. Would it be possible to describe a high (video) fidelity television receiver ncorporating special refinements? Also what about a colour television receiver? Another suggestion would be a simple receiver for use as a tunable IF offering AM/CW/FM facilities. **(M.T., Surry Hills, Vic.)**

● Thank you for your commendation and good wishes. With our last do-it-yourself TV set, and articles in "Forum," we probed the interest in high (video) fidelity and found that it was very low indeed. The price tag on commercial receivers makes it quite unattractive for people to build their own standard receivers, or for manufacturers to market parts for any such purpose. A high fidelity project would have to buck the problems of very limited interest, lack of a deliberate parts supply and the need for alignment and adjustment facilities to top off the job of construction. Commercially, a most unattractive proposition. It is too early to say what our attitude might be to colour television but, unless things change rather unexpectedly, home construction of these will also be unattractive. From a reader's point of view, the stakes would be very high. If he failed to get results from the very costly collection of components, he would probably end up separated (a) from his family and (b) from the magazine that encouraged him to build. The tunable IF is a different matter. This is one we want to do as soon as we can get around to it.

MORSE OSCILLATOR: Could you please tell me if you have any circuits of an oscillator for learning Morse code? Is a set like this against the law? **(C.M., Welshpool, Vic.)**

● We have described a number of Morse oscillators, two of our most popular ones being a "Transistorised .Practice Oscillator" published in May, 1962, and reprinted in November, 1968 (File No. 1/MO/4) and a "Low Cost Morse Practice Set," published inFebruary, 1966. (File No. 1/MO/5). We can assure you, C.M., that these practice oscillators are completely legal, because they generate only audio frequencies. To be regarded as a transmitter, they must be able to generate and radiate radio frequencies. Transmitters are illegal without a licence.

VIBRATO FOR MONOPHONIC ORGAN. I have just completed your "Simple Monophonic Organ" from the December, 1967, issue, and found it excellent. Have you published a circuit to produce vibrato, tremolo and/or glissando, and if so, please tell me the issue in which it was published. I enjoy your magazine thoroughly. **(S.M., Hobart, Tasmania.)**

● A variation of the monophonic organ was published in our January, 1968, issue, which had a tremolo circuit included, but not vibrato. We cannot assist with a glissando effect.

LISTS OF PROJECTS: I am searching for electronic information for my school project. My teacher told me of the valuable information which you have. I was wondering if you could send me a price list so I could consider which information I could afford. **(I.M. Bowen, Qld.)**

● Unfortunately, there is little we can do to help you, I.M., as we have no idea of the type of project you require. Even if we knew, we have no lists to send. Perhaps you may be able to find the project you require by searching through the index to each volume which appears in the March issue each year. Then you may be able to write again stating specifically the project wanted. The charge for reprints, etc., is indicated in the information panel elsewhere in this section of the magazine. We do not deal in parts or components.

Query service 1927

Technical queries assumed no mean importance circa 1927. They were answered in the back of each issue of "Wireless Weekly" and, for good measure, were read and discussed by the Technical Editor each Thursday evening over station 2FC, now a key station in the Australian Broadcasting Commission network.

We noticed this one in the "script" for the first week of January, 1927.

Q.: I have made the Extraordinary One-Valve receiver and can only get a whistle. I have not made the set in accordance with the instructions given and am enclosing a sketch showing my alterations. Can you account for this?

A.: Yes, very easily. You must clearly understand that, before any receiver is published in "Wireless Weekly," considerable pains are taken to arrive at the best layout and wiring system and, if departed from, as you have done, it is only natural that you will have to go over all the ground experimental work to reach satisfaction. Why not follow my scheme entirely? It's good, you know!

NEW RANGE OF RESISTORS CONDENSERS AND POTENTIOMETERS

The resistors are mainly I.R.C. and Morganite and are in a wide range of values from 100 ohms to 3 meg. in ½, 1 and 2 watt and include wire wound. LIST PRICE **$9.00** per 100. OUR PRICE $2.00 per 100. Post and packing 35c extra.

The condensers are in most popular brands and include Polyester, Paper, Mica, Ceramic and Electrolytic in values up to 8mfd. LIST PRICE **$11.00** per 100. OUR PRICE **$2.00** per 100. Post and packing 65c.

The pots, are all current types and include switch pots, and dual concentric, tandem, tab pots. etc. LIST PRICE **$12.00** per dozen. OUR PRICE **$2.50** per dozen. Post and package 60c extra.

FREE With each lot of resistors, condensers or pots. we will supply one new valve. Type 6U7G, 1T4.

Regret special values in resistors, pots and condensers cannot be supplied.

SOLID STATE GUITAR AMP.

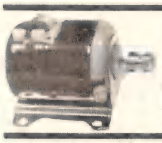
Here is a fully solid state guitar amplifier rated at a nominal 50 watts continuous power. Featuring two totally independent tone control channels and tremolo facility, the amplifier offers unique flexibility in a light and compact unit. (Featured in July-August issue Electronics Aust.)

Complete kit of parts to Electronics Aust. specifications supplied with foot control switch and lead for remote tremolo. Cabinet finished in black vinyl and control panel in black and silver with matching knobs.

COMPLETE UNIT WIRED and TESTED **$114.00**

COMPLETE KIT OF PARTS **$98.00**

FREIGHT EXTRA.



LEADER SIGNAL GENERATOR LSG11

240V A.C. operated, 6 band 120KC to 390 Megs. Provision for crystal. **$39.50**

Post N.S.W., 75c; Interstate, $1.25.

NEW TRANSISTOR 8 KIT SET

SPECIAL PURCHASE ENABLES US TO OFFER THIS KIT SET AT $24.00

- Complete kit of parts with circuit and full instructions.
- Eight transistors.
- Magnavox 5X3 speaker gives excellent fidelity.
- High sensitivity, suitable for city or country use.
- Heavy duty battery for economical operation.
- Modern design, plastic cabinet with gold trim.
- Dial calibrated for all States.
- Available in colours of off-white, red, black.

DIMENSIONS 9" x 5" x 3" deep

Post N.S.W., $1.25; Interstate, $1.75.

A TRANSISTOR PREAMP FOR MAGNETIC PICK-UP OR TAPE HEAD

Using 3 transistors per channel as featured in Electronics Aust. Complete kit of parts including transistors. P.C. board and resistors and condensers. Circuit and full details supplied.

Stereo Kit **$8.50.**

Mono Kit **$4.50.**

240V Power Supply **$4.50.**

NEW HIGH STABILITY CARBON RESISTORS 1 p.c. and 2 p.c. TOLERANCE

These imported resistors are in ½ and ¼ watt with values from 50ohm. to 1 meg. 1% and 2%. In packets of 50 mixed values.

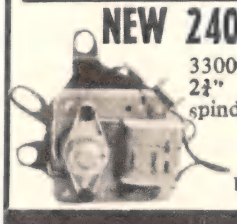
LIST PRICE 20c each.

OUR PRICE $2.00 per packet of 50.

Post and packing, 20c extra.

(Regret special values cannot be supplied.)

NEW 240V ELECTRIC MOTORS



3300 R.P.M. Size 3¼" x 2¾" x 3¼", including spindle.

$2.75

plus 60c postage

NEW P.A. AMPLIFIERS

These amplifiers are suitable for installation in clubs, schools, restaurants, factories, etc. Wherever the amplification of speech or music is required.

All amplifiers have two microphone and radio or pick-up inputs with mixing facilities and can be supplied with tapped line or voice coil output.

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25 WATT

Valve amp. using 2-6CA7, 2-12 AX7, EF86 valves. Dimensions 11in x 6in x 8in. Weight 23lb.

$61.00 Freight extra.

Amplifier with Bass and Treble Controls

45 WATT

Solid state amplifier using 9 transistors, with separate bass and treble controls. Dimensions 12in x 6in x 9in. Weight 22lb.

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New Photo-Electric Burglar & Door Alarms at less than half price

DOOR ALARMS

240V A.C. operation

$12.00

Post & Packing $1.25 extra.

Buzzer $1.25 extra.

BURGLAR ALARMS

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$16.00

Post & Packing $1.50 extra.

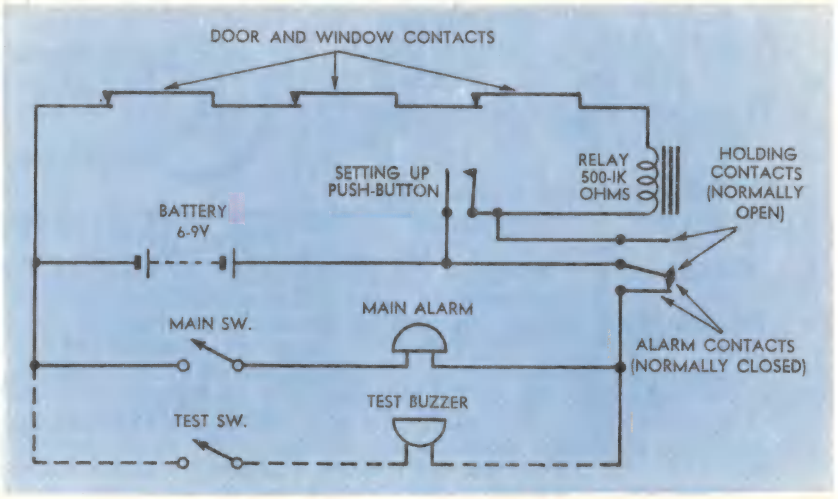
Buzzer $1.25 extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398

ANSWERS —continued

"Installing a Burglar Alarm" was featured in the September, 1967 issue. This article deals first with the broad principles of alarm systems, including a comparison between the "closed circuit" and "open circuit" systems. From this is evolved a practical circuit suitable for home construction and installation in domestic systems. The provision of door and window contacts is dealt with in detail. The overwhelming advantages of the reed switch are pointed out, followed by a detailed description and photographs explaining how these can be fitted to windows and doors without leaving any tell-tale evidence of their presence. This leads logically to a discussion of wiring techniques, again with emhpasis on concealment. Legitimate entry and exit is discussed and details are given for the construction of two-figure combination switch, using readily available parts. Finally, there is a discussion on the types of batteries which can be used to operate such a system. Copies of the article are available through the Information Service for 20c. (File No. 3/MS/14.) In addition to this main article there are several minor articles which followed it. Copies of these are available for a 20c fee each. These are: "More About The Burglar Alarm," December, 1967 (File No. 3/MS/15.) 'Transistorised Burglar Alarm" (Reader Built It), October, 1969 (File No. 3/MS/18). "Improved Burglar Alarm" (Reader Built It), March, 1970 (File No. 3/MS/21).



MODEL TRAINS: I have been an avid reader of your magazine for some time. I am particularly pleased with "Fundamentals of Solid State," by Jamieson Rowe. However, I would like to know what you have published in recent years about signalling for model railroads, particularly in relation to automatic signalling. **(P.T. Lutwyche, Qld.)**

● We are pleased to hear that you are liking the Solid State series. Many people are finding it fills the "semiconductor gap" in their electronics knowledge. This is the aim of the series. Regarding your request for information on signalling for model trains, our only description of Signalling in trains was part of the article presented in January 1968 — Model Trains, Signalling and Inertia. (File No. 2/MC/4).

MODEL CONTROL RECEIVER: I refer to the article "A 27MHz Model Control Receiver" by Anthony Leo, in the February, 1970 issue. This would be a boon if it could be designed to operate from a 5V supply, since most servos, multi and digital, operate together with their associated receiver and decoder from a 5V rechargeable nickel cadmium battery, whose size, weight and current rating is suitable for radio controlled aero models. **(A.H., Neutral Bay, N.S.W.)**

● There are practical reasons why we did not design the 27MHz received to operate from a 5V battery, mainly concerned with operating sensitivity. As we pointed out in the article in the February issue, the receiver is designed to operate from a separate power source to the associated servos and escapements. This seems to us to be the best compromise, with the receiver operating at its optimum sensitivity, from its own inbuilt battery.

FUZZ BOX: Last year I received the diagram for your "Fuzz Box" for a guitar and I built it. It did not work. I rechecked it about 5 times, and all seemed well. Then I took it to some experts (3 in all) to fix, and all said there is nothing wrong with it, but it still won't work. Could it be that the diagram or errata was wrong? What do you suggest I do? **(A.R., Mansfield Park, S.A.)**

● It seems to us that your checking must have been limited to a wiring check, A.R., and that this would have missed one of the most obvious causes of trouble — an actual faulty component. While you have not indicated how this check was made, we feel that it must be the only thing that could be wrong. The circuit diagram is quite correct, the errata refers only to a typographical error in the parts list. We have received no similar complaints from other readers. We suggest that you check each of the components in turn, and check at the same time for any dry joints, etc.

SMALL TRANSMITTER: I am a pupil of a Brisbane School, and desire to build a small transmitter using a small 9-volt dry cell battery, for entry in the school science competition. Your magazine was suggested when I made inquiries in Brisbane. I would like a small but inexpensive circuit utilising the usual types of components. Should you be able to assist I would be pleased if you would advise the cast. **(I.G., Wavell Heights, Qld.)**

● As you have not stated the type of transmitter you require, we are afraid that we cannot help you. There are so many different types of transmitters (voice, code, model control, etc.), that it would be impossible to send you the correct one. In any case, our files show very limited numbers of battery operated transmitters. Might we also remind you that all transmitters (and their operators) must be licensed. Breach of this law involves stiff penalties.

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HOW CAN YOU BECOME A PRIVILEGED BUYER?

Just fill in the coupon below and you will receive full membership of the Pre-Pak Electronics Club.

PLUS.....The latest 1970 Pre-Pak illustrated catalogue with six free supplements each year to keep you up to date with new products and prices.

PLUS.....10 vouchers each worth 10c discount on each dollar spent.

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COMPUTER BOARDS

Containing a variety of NPN and PNP germanium transistors and a host of other components, these 4in x 2½in boards are supplied with free technical information on all parts. Each board has a minimum of 4 transistors.

	PRICE POST
100 Boards	20c ea. 50c
25-99 Boards	25c ea. 25c
10-24 Boards	30c ea. 25c
1-9 Boards	35c ea. 10c

Stocks are running low. To avoid disappointment, order now.

MULLARD

Semi-Conductor
Interchangeability list, latest edition, $1.
Miniwatt valve and transistor data book, latest (7th) edition. **$3.05.**

Magnetic Pre-Amp Kitset.
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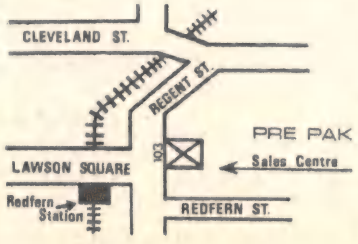

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ANSWERS – continued

OLD CATHODE RAY TUBES: In the past I have noticed that in answer to requests for circuits using disposals CRTs you have replied that, as these tubes are about twenty-five years old, they may not still be working properly. I wish to point out that neither I nor a friend have encountered any "duds" out of eleven tubes purchased, including types 5BP1 and VCR97. While there are plenty of "duds" about, if one purchases a CRT that looks intact and fairly clean with functioning heaters the chances of striking a "dud" are fairly slim. I would suggest that you could reprint previous TV circuits using old CRTs and perhaps present a receiver using an old commercial chassis driving one of the tubes mentioned. **(M.N., Balwyn, Vic.)**

● While we must respect your experience, our observations have suggested that a lot of wartime tubes which readers may be tempted to use could be faulty, leading to frustration and added expense. What is more, the money saved by using a cheap tube can readily be offset by the more expensive metalwork needed to accommodate their bulk and the cost of the circuitry needed to meet the higher voltage and higher drive requirements for a given order of performance. As for the VCR97, there are problems in using this tube because its construction and geometry varied from one manufacturer to another, particularly with regard to the vertical deflection plates. While it is possible to get quite pleasing results from an old TV chassis driving a CRT, this is not a practical proposition for a magazine article. Unfortunately, no two chassis are the same and often parts are not standard, which can mean extensive improvisation on the part of the constructor. While improvisation and modification of circuitry is no problem for constructors with the necessary background and know-how, not everyone is so placed.

GUITAR AMPLIFIER: I have just completed the 50-watt guitar amplifier, and have got it working. I am most pleased with it and find it 100 per cent better than a commercial unit which I purchased for $500 a few years ago. It was supposed to be rated at 60 watts. Have you ever published a circuit for a "Waa-Waa" box—if not, have you any plans for doing so? **(V.S., Higgins, A.C.T.)**

● We are pleased to hear that you like the amplifier, V.S., especially in comparison with a commercial one. A "Waa-Waa" unit was described as a "Reader Built It" in May, 1967. For the benefit of those readers who have never heard of a "Waa-Waa," it is a device which puts a movable peak into the frequency response of the amplifier, so introducing a "wailing" sound to the output. It is featured in many "pop" records.

MODEL CONTROL: I make model boats powered by electric motors. I should like to fit them with remote control units. Have you any plans for the construction of remote control units? If so, how can I obtain them, and what is the price. **(R. F., Caloundra, Qld.)**

● The following articles should assist you: A Radio Control System for Modellers, parts 1 and 2 (December, 1965 and January, 1966), File Nos. 3/MC/3 and 4; A 27MHz IC Superhet Receiver (February, 1970), File No. 3/MC/5. These articles deal with the electronic equipment only, not with the various escapements and relays used in model control. Reprint material may be obtained through the Information Service for 20c each article, by quoting the title and file numbers.

CHASSIS OR CHASSES?: May I take you to task for using the word chassis as a plural noun? The phrase, "These chassis" appears on page 92 of the October 1969 issue. Not the first time your magazine has erred in this respect either. Some of your advertisers are equally remiss. For your information the plural of the (French) word chassis is chasses. If you think I am being pedantic I can only say that if you consider it correct to use the word styli as the plural of stylus then logically it should be good enough to do the same for other semi-technical words. **(J.S., Mt. Eden, N.Z.)**

● Others have raised this point in the past J.S., but we feel that we are justified in using this form. One most important reason, to us, and regardless of the "rightness" or "wrongness" of the spelling is simply that this is the house style of the parent company of which we form a part, and has been so for as far back as most serving members can recall. And when a printing organisation says, "This is house style," you create all kinds of problems, if you try to buck it. For example: A single article in this magazine might be set by, typically, six different compositors. Some will "follow style," others will "follow copy." The result in the final compilation of the article, is chaos, with much time wasted making corrections and having them re-set. But apart from that, it appears that our parent company had good reasons for taking the decision they did. House rules are based on the Oxford dictionary which says; "chassis. . . n. (pl. the same)." A French interpreter in our building — a native of France — confirmed this spelling and quoted the following rule: French words form their plurals by adding "s," or "x" in some cases, to the singular form. When the singular form already ends in "s" it is the same in the plural form. As a matter of interest, words which end in "is" in the singular form and change to "es" in the plural form are those of Greek origin, for example, "crisis" and "crises."

ECONOMY RECEIVER: I think that your new 240 Communications Receiver is terrific. I am building it and hope to finish it before I run out of money I have a friend on a tighter budget and we were wondering if you could describe a simpler receiver with about 8 to 10 transistors, with a performance comparable with 1967 All-Wave Seven. A suggested line-up could be: A FET mixer with a local tunable oscillator, followed by a second mixer, with a fixed tuned oscillator. This could be followed by a ceramic filter assembly, into an IC IF amplifier, similar to that used in the Model Control Receiver. An AM and product detector, with a simple BFO and an audio system, would complete the line-up. When are you going to describe an SSB transmitter with ceramic filters, as mentioned earlier? Can you please give me the address of the Secretary of the S.A. Division of the Wireless Institute of Australia? **(G. F., Marion, S.A.)**

● We are pleased to know that you like the new 240 Communications Receiver and we wish you well in building it. Thank you for your suggestion for a simpler receiver. As a matter of fact, we were already thinking along somewhat similar lines for an economy general coverage receiver. Although it does not conform with your suggested line-up, nevertheless we envisage that it will have about 12 transistors and it will do all that you have suggested. In point of fact, we have already done a lot of developmental work on it and we hope to describe it within a few months. We would like also to do some work on an SSB generator using ceramic filters but time is preventing us from getting on with such a project. The addresses of all the Divisions of the Wireless Institute of Australia are published in our "Amateur News and Notes" at frequent intervals. By coincidence, the latest list appears in this issue on page 163.

MODEL CONTROL: I wish to obtain a circuit for a three or four channel solid-state radio control unit for model planes. I don't want anything too expensive. **(C.H., West Dubbo. N.S.W.)**

● Unfortunately, all we can offer is the receiver published in February, 1970 (File 3/MC/5) and the transmitter and receiver published in December 1965 and January 1966 respectively. (File Nos. 3/MC/3 and 3/MC/4). These are the only radio control systems we have described. ■

THE SERVICEMAN

(Continued from page 95)

seem to be most illogical. The frame of a van is in no sense a true "earth." On the contrary, it is normally very well insulated from earth while ever it is supported by only its own wheels and the towing vehicle. As has been so tragically demonstrated, any fault which brings the active line into contact with the frame renders the van (and any towing vehicle still connected to it) into the most vicious death trap.

On the other hand, I cannot see that including the frame in the earthing system has any advantages. The earth connection should be provided by the third wire in the connecting cable and the appropriate pin in the outlet socket. If this part of the system is at fault the remedy is obvious; correct it. But it would seem to be quite pointless to depend on the quite random earthing likely to be provided via the frame and the stabilising legs. After all, there is no guarantee that these legs will even be metallic, or make effective contact with the ground. As just one example, one can readily imagine these legs being supported on a piece of wood, or other insulating material, in situations where soft or uneven ground presented a stabilising problem.

In regard to electrical accidents generally the report — which, incidently, also reported the caravan fatality referred to by our correspondent — emphasised that in no case was the appliance itself at fault. In the great majority of cases it was either a damaged cord or a incorrectly wired plug.

Which seems to put the responsibility fairly and squarely back on the "handyman" who thinks he knows all about it, but doesn't. ■

VARIETY FARE

(Continued from page 137)

presentations, these two pieces will repay careful study over a period of months.

The album also features two established Modern Jazz Quartet pieces — "Dilema" by the young Yugoslav composer, Miljenko Prohaska; and the "Adagio from Concierto de Aranjuez" by Joaquin Rodrigo.

"Dilemma" in particular finds the Modern Jazz Quartet at peak form with beautiful, subtle interplay between vibes, piano bass and percussion, and excellent solos particularly by Milt Jackson.

The album is completed by a superb version of the wonderful Burke Van Heusen ballad "Here's That Rainy

RADIO: Unofficial history

To the real oldtimers, the 1940s mightn't seem all that long ago but they were far enough back to have their own primitive quality by present-day standards. Particularly in the country, in those days, a call to the local radio man would prepare him for any job from fixing a radio to engine or generator repairs, welding, or merely soldering a copper kettle!

One such call reached me from a client in the Inmam Valley district, in the southern part of South Australia. He complained about severe static in his radio set whenever he ran the engine to charge his home lighting batteries.

I had only to listen to the radio to know that the trouble was hash from arcing brushes in the generator — a fairly common fault, I might mention.

In this case, and true to form, the generator set was located a fair way from the house.

My first surprise was to find the equipment elevated about four feet above the floor of the engine shed. The second was to find a galvanised bucket suspended from the generator brush gear. Closer inspection increased my bewilderment: the bucket was half full of water.

Seeing my puzzlement, the owner explained that he used the bucket to control the pressure of the brushes against the commutator and that it could be adjusted very precisely by varying the amount of water!

Without having a clue as to why he had gone to this trouble, I could see that the brushes were barely skimming the surface of the generator, creating a generous display of sparks as they did so. No wonder there was "static" in the radio.

I therefore uncoupled the bucket, dressed the brushes, cleaned the commutator and set the charging rate for a steady 15 amps.

But the owner wasn't satisfied. With a look almost of scorn on his face, he fiddled with the carburettor until the motor was running erratically and the ammeter was swinging madly from +15 amps down through zero to the discharge region. Then he stood back satisfied.

At this point I could stand it no longer and, in a manner appropriate in the country asked him why the so-and-so he had done that.

His answer was most enlightening.

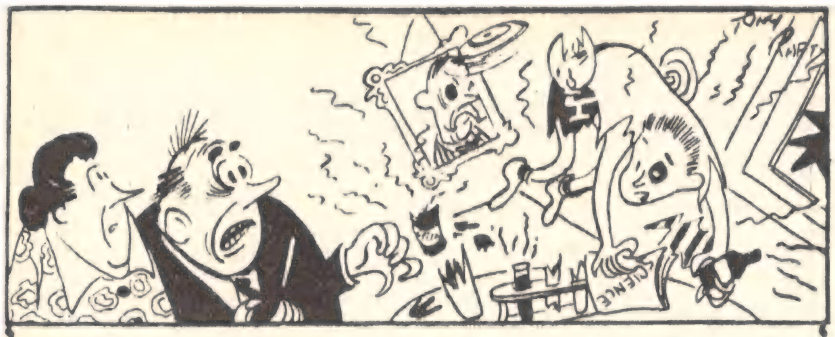
Any fool should know that you couldn't pump up batteries with the ammeter steady! You had to have the needle pumping up and down to show that it was pumping up the batteries!

Taking the bucket away might have fixed the hash but I'd stopped the generator pumping. That left him no alternative but to fiddle with the carburettor!

I tried to point out the error in his reasoning but, I'm not sure that he was really convinced.

Nor am I sure which one of us was more bewildered: The property owner or the serviceman who finally made his way to the front gate! (From W.B., Victor Harbour, S.A.)

(Readers are invited to submit contributions to "RADIO: Unofficial History" and a publication fee will be paid for those used. Stories must be humorous and they must be true. Letters must be signed and the locale of the story indicated as a mark of good faith. The Editor reserves the right to re-phrase contributions as necessary to preserve uniformity of style.



Here's the third—and last—of the episodes, originally presented in the August 1946 issue, and written in the style of the then well-known Stanley Holloway monologues. Getting away from electronics, it was composed by our science writer of the period, Calvin Walters.

Young Albert came home from his stoodies
All sprightly and full of high jinks,
He'd learned in his chemistry lesson,
To make oop explosives and stinks.

He took money box from the coopboard,
And ran down to chemical store,
Came home with some glass tubes and bottles,
And packets of powder galore.

His father said, "What's big idea?
"I'm tired of your pranks, that I am
"Thas had me run in by inspector,
"When tryin' to be ruddy Ham."

"Tch, Tch" said his Moother right smartly,
"Tha knows the poor lad's got to learn,"
"I know it," said Pa. "And I'll teach 'im,
With boot on back of 'is stern."

But Albert went off quite determined
And started to fiddle with kit
When all of sudden, explosion
Made Ma and Pa 'most take a fit.

They both hurried off into bedroom,
And found a great 'ole burnt in mat,
Their Albert was 'anging from gas jet,
And 'alf the fur burnt off the cat.

Next day when Ma went to use laundry,
Things got into 'orrible fix,
The boy had been using the copper
To make oop some 'orrible mix.

Pa's shirts went a bright shade of purple,
Ma's skirt turned from red into blue,
Big boobles came frothin' from copper,
And red flames licked out of the flue.

Young Albert were greatly encooraged,
He ran round with book under arm,
Said he, "Don't tha woory, I'll fix it,
Directions will work like a charm."

He took ploog from bottle marked "Acid,"
And placed it on stove to get 'ot,
Just imagine surprise and amazement
When bottom came right out of pot,

The acid got all round the kitchen,
Burnt holes in the covering of floor,
The soles of Ma's boots went all mooshy,
And handle came loose from the door.

When Pa returned home from the office,
He said, "It's a mess I must say,
Tha'll kill us all yet with thy foolin',
Get into thy room, lad, and stay."

Next morning, when Pa went to bathroom
To shave in his usual roosh,
He found with expressions of anger
That bristles came out of the broosh,

The silver was all flakin' off mirror,
And paintwork was peelin' like Lace,
When moother got undressed for shower,
The gas jet blew oop in her face.

When landlord came around the next mornin',
He shouted, "Thy lad's just a freak,
To cover the cost of destrooction
I'll raise the rent ten bob a week.

To finish this tale right and proper,
Young Albert was spanked hard and neat,
On place that's so sore and so tender,
He stands oop his supper to eat.

Day." The melodic and harmonic simplicity of this track contrasts vividly with the other four compositions.

On the basis of limited playings, I would not wish to suggest at this stage that "Space" — good though it is — should be regarded as a milestone in the group's development. But their music mellows like fine wine and this LP may yet prove to be significant for Lewis' avant-gardish writing on "Venus" and "Mars."

In the meantime, the many admirers of the Modern Jazz Quartet in Australia will no doubt wish to add this album to their shelves without delay. (T.F.C.)

★ ★ ★

STOMPIN' — Fats Domino. Liberty (Festival) SIRL 933316.
Interest: R. and R.
Performance: Enthusiastic.
Quality: Poorly recorded.
Stereo: Adds little.

Fats Domino, the 42-year-old New Orleans singer, pianist and songwriter, was one of the biggest names in the 1950s rock-and-roll explosion. Indeed, he is still very popular, working regularly with his existing band all over America and from time to time in Europe.

No recording date is given for the ten tracks in this album but I suspect that they are not recent recordings. Several of his big hits are included—"Every Night," "All By Myself," "Are You Going My Way," and "Be My Guest." Domino, in fact composed all but three of the numbers and, with the exception of "Domino Stomp" the tracks feature his singing.

Fats Domino fans will certainly buy this album but they should be warned that it is a $5.75 release, with the lamentable playing-time of 23 minutes. (T.F.C.)

AMATEUR BAND

(Continued from page 171)

As you are aware, amateur radio activity in the world has been progressing very rapidly and has now reached the stage of satellites also. I understand a special satellite for radio amateurs was launched some time back. Indian amateurs should, of course, not lag behind in taking advantage of the new dimensions made possible by space technology.

With the rapid growth of telecommunications all over the world, the requirements of radio frequency spectrum are growing rapidly. Views are sometimes expressed that allocation of bands to less important services should be curtailed and as you are aware, there always has been talk of reducing the spectrum allocated to radio amateurs. While the importance of radio amateur activity is fully appreciated it is for our young generation as well as the veterans to demonstrate that the use of this frequency spectrum, specially allocated to amateurs, is fully justified.

A determined and co-operative effort in this field would, I am sure, reduce the problems of cost and other considerations and would pave the way for a bright future for this hobby, which can play a vital role in the development of radio and electronic technology in the country.

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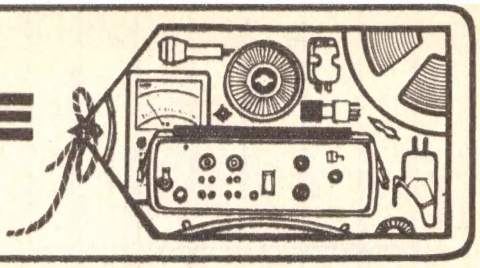

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FOR SALE

PLAYMASTER 115 stereo amplifier, $60.00 working but some work needed, regulated P/S, magnetic amp, but no cabinet. 8 Clifford St., South Brighton, S.A.

RESISTORS, Carbon film ⅛ plus ½W 10%—6c ea; 1W—10% ⅛ plus ½W 5%—7c ea; 1W — 5% 8c ea; Packing add 10c. Hobipak, P.O. Box 224, Carlton South, 3053.

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TRANSISTORS, 2N3055, 1.60. Matched pr. 3.40. 2N3053 1.20. BC108, 109, OC171, 50c. AD161/162, 2.70, AC187/188, 1.70, AC127/128, 1.20, BC107, BF115, 60c. OC44, 45, 71, 72 45c. 2N1439, MPF105, 1.00. 1W zeners 9 or 12v, 1.25. SCR 15A 100v, 2.10, 400V 3.50. OA202, 25c. OA91 type, 18c. 1N4004 1A 400v 40c; IN4006 800V, 60c. 6 amp 400V stud diodes 70c. Pots ganged 470K x 470K log 47K x 47K log 1.40, single 47K lin. 47K lin. 40c. Post 10c. T. & M. Electronics, Box 57, Post Office, Haberfield, 2045.

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WANTED

COMMUNICATIONS receiver required, 530KHz-30MHz, preferably two RF stages filters, J. Heron, 8 Pine St., Wynnum, Qld. Telephone 072 963849, 8-5 week days.

MINIFON pocket recorder with attachmenuts or similar miniature wire, tape recorder. G.P.O., Box 1233, Brisbane.

TV Sweep gen. and other test inst. In or out order, home made O.K. also bits and pieces, especially C.R.O. tube, cap and inductive sweep units, Ph. 85 4229, 31 Carson St., Dundas, N.S.W.

POSITIONS VACANT

LABORATORY TECHNICIAN (ELECTRONICS)
ROBINSON COLLEGE, BROKEN HILL,
UNIVERSITY OF NEW SOUTH WALES.
Salary: $3954 range $4129 per annum. Commencing salary according to qualifications and experience. Climatic and disability allowances of $208 per annum (single man) and $312 per annum (married man) are also paid.
Extensive superior experience, qualifications in the electrical field and superior knowledge of electronic equipment. To supervise, service and repair electrical equipment used for teaching and research. Further information from Associate Professor I. L. Johnstone from whom application forms may be obtained. Applications should be lodged with Appointments Office, P.O. Box 1, Kensington.

TECHNICAL sales clerk, male. An electronic hardware manufacturing company requires a young technical sales clerk with the Leaving Certificate and some practical experience in electronics. The successful candidate will be fully trained in the sales office and future prospects for promotion to the position of technical sales representative are excellent for the right man. Salary will be negotiated according to qualifications and experience. For an appointment please phone Mr P. Cohen on Melbourne 544 3033. McMurdo (Australia) Pty. Ltd., 19 Carinish Road, South Oakleigh, Vic., 3167.

LABORATORY ASSISTANT (ELECTRONICS)
SCHOOL OF TEXTILE TECHNOLOGY
UNIVERSITY OF NEW SOUTH WALES
Salary (adult): $2,835 range $3,648 per annum. Commencing salary according to qualifications and experience; juniors according to age.
Applicants must hold an approved technical college certificate, preferably in electronics, have completed at least two stages of a part-time degree or diploma course in science, engineering or applied science or have equivalent qualifications.
Applicants without formal qualifications but with trade experience in radio electronics and ability to carry out assembly work and modification of experimental circuits under supervision would be considered for appointment as laboratory attendant with salary in the range $2,598-$2,835 per annum (adult); juniors according to age.
Application forms from Appointments Office, P.O., Box 1, Kensington.

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BEOGRAM 1500

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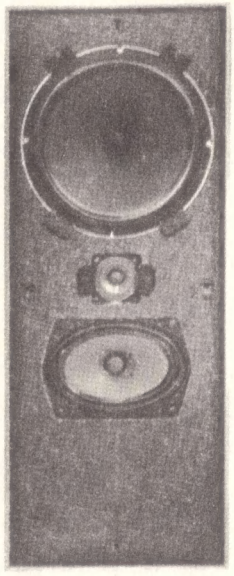

TRANSCRIPTION TURNTABLE:
3 speeds with fine adjustment ± 10%.
Rumble: appr. 35 db below rev. level.
Wow: ± 0.2% peak value.
Cartridge: magnetic SP7 or SP9 ellipt.
Pick-up arm: ST/L 15° anti-skate.

CONNECTIONS:
Inputs:
Radio: 150 K ohms-50 mV/1000Hz.
Tape: 50 K ohms-50 mV/1000Hz.
Output:
Speakers: 3-8 ohms.
Tape recorder:
22 K ohms-1000 mV/1000Hz.

AMPLIFIER:
Output: 32 watts peak (2 x 8 rms).
Frequency response:
20Hz-20KHz ± 2 db.
Distortion: less than 1% at 5 watts.
Signal/Noise ratio: 60 db linear.
Crosstalk: 45 db at 1000 Hz.
Tone Controls:
Bass Control: ± 10 db at 50 Hz.
Treble Control: ± 10 db at 10 KHz.
Push-button controls for on/off, tape recorder, radio and record player.
A transparent dust cover comes with the unit. Base: teak or palisander.

Speakers: Low frequency unit, mid-range unit and high frequency unit.
Crossover frequencies: 900/5000 Hz.
Frequency response: 40-18000 Hz.
Impedance: 4 ohms.
Peak load: 35 watt (20W continuous).
Distortion: max. 2.6% (DIN 45 403).
Resonance of bass speaker: 35-40 Hz.
Angle of coverage: 90°
Dimensions:
240 x 600 x 275 mm deep.
Choice of teak or palisander.
Connections: Input: DIN plug 4 ohms.
Output: Treble speaker 4 ohms.

Melbourne: Danish Hi-Fi P/L Camberwell Branch & New City Showrooms At Shop 9. Southern Cross. Elanco, Myers, Thomas'

Adelaide: Macks Electronics. The Muses Sound Spectrum.

Canberra: J.B. Young

Perth: Leslie Leonard &Co.

Sydney: Braodway Electronics (Sales). A. Victor & Co.

Newcastle: Dynamic Sound

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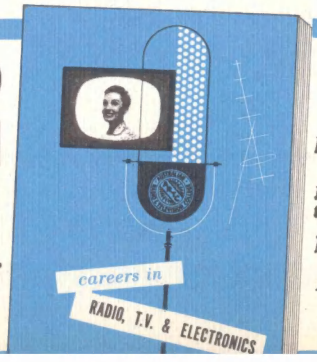

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